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SCHØYEN (T. H.) & JØRSTAD (I.). **Skadedyr og sykdommer på grønnsakvekstene.** [Pests and Diseases of Vegetable Crops.]—9×6 ins., 142 pp., 22 col. pls. 17 figs. Oslo, H. Aschehoug & Co. (W. Nygaard), 1949.

The first and major section of this handbook on pests of garden and greenhouse vegetables in Norway contains concise accounts of the appearance, habits and control of a large number of insects, fungi, etc., arranged under the crops they attack, with illustrations of many of them showing the kind of injury they cause. The second section consists of a review of the various available methods of chemical control, with notes on the composition and uses of many sprays, dusts, bait materials, soil insecticides and greenhouse fumigants. A table enabling the various pests to be identified from the type of injury observed on the plants is appended.

BLANCHARD (E. E.). **Tres nuevos Himenópteros útiles para la agricultura.** [Three new Hymenoptera beneficial to Agriculture.]—*Rev. Invest. Agríc.* **2** no. 1 pp. 57–64, 3 figs. Buenos Aires, 1948. (With a Summary in English.)

The new species, all described from Argentina, are *Bracon* (*Microbracon*) *cuyanus* reared from larvae of the potato tuber moth, *Gnorimoschema operculella*, Zell.; *B.* (*M.*) *littoralis* from the Arctiid, *Utetheisa ornatrix*, L., which attacks the seeds of *Crotalaria*; and *B.* (*M.*) *montesi* from the tobacco stem borer, *Faustinus cubae*, Boh. A key is given to these species and two others of the same genus frequently reared from injurious Lepidoptera in Argentina.

HUNT (G. M.) & SNYDER (T. E.). **An International Termite Exposure Test—Seventeenth (—Nineteenth) Progress Report(s).**—[*Proc.*] *Amer. Wood. Pres. Ass.* [**42–44**] preprints 16, 16, 15 pp. [Baltimore, Md.] 1946–48.

In these three progress reports on the effectiveness of various chemicals in preserving specimens of wood from attack by decay and termites [*cf. R.A.E.*, A **34** 380, etc.], data are tabulated on the condition in 1945, 1946 and 1947 of the specimens installed in 1928, 1929, 1931, 1933, 1938, 1940 and 1941. It is stated in the third of them that although the average life of the stakes is the most reliable criterion of the effectiveness of a treatment, the results apply only to the conditions of the particular tests and that general conclusions should not be drawn from them.

BORG (Å.). **Ett bepudringsförsök med DDT- och hexapreparat mot jordgubbsvecklaren.** [An Experiment with Proprietary Dusts of DDT and Benzene Hexachloride against the Strawberry Tortricid.]—*Växtskyddsnotiser* 1947 no. 3 pp. 33–36, 2 figs. Stockholm, 1947.

Advantage was taken of an outbreak of *Acleris* (*Acalla*) *comariana*, Zell., in a large planting of strawberries in southern Sweden in May 1947 to test several proprietary dusts against the larvae. The dusts were applied in sunny but rather windy weather. Counts of living larvae on sample leaves six days later showed that those containing DDT were fairly effective, while Cryocide [cryolite] and dusts containing nicotine or benzene hexachloride were useless. Since the benzene-hexachloride dusts proved more toxic than DDT to certain other insects in the laboratory, it is concluded that they should not be applied in windy weather.

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Mathlein (R.). **Inverkan av DDT- och hexapreparat på kvaliteten hos brödspannmål.** [The Effect of DDT and Benzene-hexachloride Preparations on Flour.]—*Växtskyddsnotiser* 1947 no. 3 pp. 36–39. Stockholm, 1947.

Since dusts containing DDT and benzene hexachloride are known to be effective when mixed with stored grain against insects attacking the latter, their possible effect on flour and bread prepared from treated wheat and rye was investigated in Sweden. Proprietary dusts were mixed with the grain at the rates recommended by the manufacturers and at five times these rates, and the grain was kept for 22 days in paper bags, after which light débris were removed by fanning, the moisture content was raised to 16·5 per cent. and the grain was stored for a further few weeks before milling. The flour was kept for three weeks in closed vessels, and bread then baked from it. Examination showed that treatment of the grain at the recommended rates had no effect on the quality of the flour and bread, but both insecticides at the increased rates caused an unpleasant smell and taste in both. Data on their toxicity to mammals are briefly reviewed, and it is concluded that, at the rates used in practice, neither would constitute a danger to man.

Wahlin (B.). **Betjordloppan angriper oljelin.** [The Beet Flea-beetle attacks Flax.]—*Växtskyddsnotiser* 1947 no. 3 pp. 39–41. Stockholm, 1947.

Flax in Östergötland (south-eastern Sweden) was severely injured by adults of *Chaetocnema concinna*, Marsh., in June 1946, largely as a result of the dry spring, which retarded the growth of the plants. Dusting with DDT and benzene hexachloride controlled the flea-beetles, but did not enable the plants to recover.

Witte (A.). *Gilletteella cooleyi* **(Gill.) (Hem. Aphidina) i Sverige.** [*Chermes cooleyi* in Sweden.]—*Opusc. ent.* **12** no. 4 p. 172. Lund, 1947.

Chermes (*Gilletteëlla*) *cooleyi*, Gill., was observed on Douglas fir [*Pseudotsuga taxifolia*] at nine localities in the extreme south of Sweden in 1947, for the first time in that country. As in other parts of Europe, it seemed able to develop without migration to spruce, though it caused some galls on spruce trees close to infested Douglas fir. It is not anticipated that it will prove very injurious in Sweden. It was observed in Denmark in 1938.

Plantesygdomme i Danmark 1945(–1946). Plant Diseases and Pests in Denmark 1945(–1946).—*Tidsskr. Planteavl* **51** pp. 373–437, 2 graphs; **52** pp. 236–292, 2 graphs, 1 fig.; also as *Aarsovers. Plantepat. Forsøg* nos. 62–63. Copenhagen, 1948. (With Summaries in English.)

These two reports contain sections (pp. 409–428 and 267–281) in which P. Bovien surveys the principal pests of cultivated plants in Denmark in 1945 and 1946 as in previous years [*cf. R.A.E.*, A **34** 116]. Insects that caused unusually severe damage in both years included *Tipula paludosa*, Mg., on many field crops, especially cereals, *Bibio hortulanus*, L., on barley following swedes and beet, *Pegomyia hyoscyami*, Panz., on beet, *Contarinia nasturtii*, Kieff., on cabbage and swedes, *Nematus* (*Pteronus*) *ribesii*, Scop., on gooseberry (especially in 1945) and *Anomala* (*Phyllopertha*) *horticola*, L., which was injurious to field crops and fruit trees and occurred in very large numbers in 1946. In 1945, celery was injured in autumn by *Lygus kalmii*, L., and poppy was infested by *Carpodiplosis papaveris*, Kjell. [*cf.* **34** 59], a Cecidomyiid not previously found in Denmark. Damage to crucifers by *Plutella maculipennis*, Curt., and to carrots in Jutland by *Trioza apicalis*, Först., was unusually severe in 1946. In the same year, both *Eriosoma lanigerum*, Hsm., and its

parasite, *Aphelinus mali*, Hald., spread on apple, and *Otiorrhynchus tristis*, Scop., which had not previously been reported as a pest in Denmark, gnawed young apple twigs. A severe outbreak of *Autographa* (*Plusia*) *gamma*, L., occurred in July, and the larvae injured very many field crops and even young fruit trees. Pupation began in the middle of the month, and adults were numerous in August and the first half of September. There was little reproduction. Some females oviposited in a field cage, and of the larvae reared, the oldest pupated in September and the others died with the onset of frost. All the pupae were dead by the spring of 1947, and it is concluded that the species is an immigrant and cannot normally overwinter in Denmark.

RICHARDS (O. W.). **Observations on Grain-weevils,** *Calandra* **(Col., Curculionidae). I. General Biology and Oviposition.**—*Proc. zool. Soc. Lond.* **117** pt. 1 pp. 1–43, 6 figs., 11 refs. London, 1947. **The Interaction of environmental and genetic Factors in determining the Weight of Grain Weevils,** *Calandra granaria* **(L.) (Col., Curculionidae).**—*Op. cit.* **118** pt. 1 pp. 49–81, 6 figs., 9 refs. London, 1948.

Between 1939 and 1945 a study was made in England of the biology of grain weevils, chiefly *Calandra granaria*, L., but also including the two strains of *C. oryzae*, L. [*cf. R.A.E.*, A **33** 361], in wheat. The results were divided into seven sections under the headings of technique, general biology, oviposition (special studies), factors determining the weight of weevils, factors determining resistance to starvation, genetical experiments on characters other than weight and resistance, and population biology. The first of these papers deals with the first three subjects, and the second with the fourth. The following paragraphs are virtually the author's summaries of them.

Methods for handling grain and weevils for experiments with *Calandra* are described. Nearly all the experiments were conducted at 25°C. [77°F.] and 70 per cent. relative humidity. The dimensions of the eggs and the head-widths of the four successive larval instars of *C. granaria* are recorded. The rate of sexual maturation and the effects of this process on the readiness of weevils to pair are described for both strains of *C. oryzae* and for *C. granaria*. Records are given of frequency of pairing, choice of mate in relation to weight, effect of ovarial development on readiness to pair, length of the oviposition period and number of eggs laid, length of life, and effect on oviposition rate and on fertility of one or more pairings. The rate of development of weevils at 21°C. [69·8°F.] and relative humidities of 50, 60, 70 and 80 per cent. is recorded. Normally, only one larva can develop in each grain, and the elimination of supernumerary ones is described. A larva developing at 25°C. turns about 14 mg. grain into carbon dioxide and water, and produces about 14 mg. frass to become a weevil weighing 2·4 mg. The emergence of adult weevils from the grain in which they have developed is stimulated by shaking the grain. In both strains of *C. oryzae* and in *C. granaria* the sex ratio is not far from unity. There is some evidence that cultures derived from a single female parent produce rather fewer males than mass cultures. It is shown that oviposition rate, though variable, is reasonably constant over ten-day periods. There is little evidence for any periodic variation. The weight of the female, the number of eggs in the ovary and the oviposition rate are all more or less correlated. There is some evidence that the relation is due to the environment that has acted on the female rather than to genetic constitution. If weevils are matured in crowded conditions, it is apt to reduce their oviposition rate afterwards. Single weevils lay better in large quantities of grain than in one or two grains. With as many as 600 grains, it makes no difference whether it is deep or shallow, but fewer eggs per 100 grains were laid by groups of 20 females on 600 grains than by 40 females

on 1,200. This effect could not be demonstrated in single weevils. With groups of 20 females, oviposition falls significantly if there are fewer than 10 grains per female, and there is some evidence that about 50 grains per female are really required for maximum egg-laying. The depressing effect of population density is partly due to the saturation of grain with eggs, partly to mutual interference, in which virgin females are as effective as fertilized ones. Males have a still more depressing effect. In a normal grain sample (grain-size normally distributed), oviposition is effectively random, though grain-size determines which grains receive the higher number of eggs. Grains containing fourth-stage larvae are avoided. At 21°C., oviposition increases slowly as the relative humidity rises from 70 to 100 per cent., and falls rapidly if it is reduced below 70 per cent. The same is true at 17°C. [62·6°F.] and 25°C., though the data at these temperatures are less reliable. The amount of oviposition at 17, 21 and 25°C. is probably in the proportions of 43 : 100 : 268. Oviposition ceases at about 9·5°C. [49·1°F.].

Cultures that are deeper (up to 11 cm.) or in which the infestation is fairly dense (up to 150 examples per 100 grains) produce the heaviest weevils. The central part or the bottom half of a culture produces heavier weevils than the top part. Cultures left undisturbed produce heavier weevils than those that are disturbed earlier. The weevils from nearly all cultures exhibit a weight-cycle. The first ones to emerge are light ; those that emerge at the time of maximum emergence are heaviest, and those that emerge last are lightest. On the whole, conditions that produce heavier weevils induce a more marked weight-cycle. Nearly all the effects on weight described above must be attributed to the influence of the metabolic products that accumulate to a greater extent in deep and crowded cultures. Part of the weight-cycle, however, is due to genetic factors, so that it may be observed in very shallow cultures. A weight above the mean is correlated with a shorter developmental period, and both characters are inherited. There is no evidence that reduction of weight in overcrowded cultures or at the end of the emergence period is due to competition of larvae within the grain. Larger grains produce heavier weevils, even though the whole of the grain is not utilised by the larva. Deeper, more heavily infested cultures become hotter and damper and accumulate more carbon dioxide. Some evidence was obtained that accumulated carbon dioxide reduces the weight of the weevils. None was found for the view that water affects weight. The physiological basis for the increase in weight in deeper, more crowded cultures is not known. There appear to be two principal genetic weight types in *C. granaria*. When cultured in 3 × 1-in. tubes, these have mean weights of 1·90 and 2·46 mg. In the small line, a subsidiary type of mean weight, 2·07 mg., could later be selected out. In both lines, weevils of which the mean weight was more than 5 per cent. below the mean of the line produced very few offspring. Selection for larger size in the large line was ineffective, partly because of differential fecundity. There was some evidence for the occurrence of a gene producing premature death of the adult weevils in the last two inbred generations. Weevils increase in weight by about 5 per cent. in about the first third of their lives. On the whole, lighter weevils and those with a shorter developmental period tend to put on more weight, though not enough to obscure any initial weight-cycle. It is suggested that attention should be paid in population studies to the quality as well as to the numbers of the insects produced.

Ross (D. M.), Stapley (J. H.) & Cockbill (G. F.). **Wireworm Populations in relation to Crop Production. V. Comparisons between failing and successful Plots.**—*Ann. appl. Biol.* **35** no. 2 pp. 193–206, 1 fig., 12 refs. London, 1948.

The following is the authors' summary of this paper on work in England in 1945, which forms part of a series [*cf. R.A.E.*, A **37** 71]. It is well known that

infestation is only one of a number of factors which determine the amount of wireworm damage occurring in a field. As an attempt to analyse the conditions under which crops fail from wireworms, 13 fields showing both damaged and undamaged areas were studied. Data were collected on wireworm populations, chemical and mechanical composition of the soil, feeding reactions of the wireworms collected, agricultural history and treatment of the different plots and fields. In six only of the fields did the damaged areas coincide with areas of higher infestation. In the remainder, the failures occurred at low populations, and no marked differences in population could be detected between the failing and successful plots. The levels of population at which the failures occurred varied between wide limits in the different fields. Two of the edaphic factors investigated were associated consistently with the failing and successful plots ; $CaCO_3$ was consistently higher and sand content consistently lower on the failing plots. Differences in these factors were particularly noticeable in those fields where differences in infestation were not detected. There is a suggestion from four of the fields that wireworm attack commonly follows sainfoin [*Onobrychis sativa*]. None of the other factors showed significant relationships. Although the results suggest that differences in one or more of the factors, infestation, $CaCO_3$ and sand, are associated with differences in wireworm damage within fields, the differences between the fields cannot be explained so simply. Evidently, other factors, relatively uniform within single fields but varying from field to field, also influence the amount of wireworm damage. Consideration of the results in relation to wireworm and plant populations brings out the need for greater attention to the rôle of wireworm activity and the environmental factors which influence it. The importance of reliable methods for predicting wireworm damage to any methods of control is stressed.

HEWLETT (P. S.). **The Formation of insecticidal Films on Building Materials. III. Supplementary Laboratory Tests on Size and Gelatin as Pretreatments.**—*Ann. appl. Biol.* **35** no. 2 pp. 228–232, 4 refs. London, 1948.

The following is almost entirely the author's summary. Experiments in continuation of those already noticed [*R.A.E.*, A **37** 137], again with *Tribolium castaneum*, Hbst., as the test insect, showed that pretreatment of cement with 10 per cent. w/v size or 5 per cent. w/v gelatin greatly prolonged the duration of toxicity on it of the films formed by other insecticides, notably DDT, as well as pyrethrins, when these were applied in oil.

The effects of adding different substances to size and gelatin solutions as pretreatments were investigated. Solutions containing 5 per cent. w/v size or gelatin with the addition of suspended lime or distemper powder were, with the exception of gelatin containing distemper, less effective pretreatments than size or gelatin solutions alone. Magnesium fluosilicate, benzoic acid and salicylic acid, at concentrations up to 0·5 per cent. w/v, appear suitable as preservatives for 5 per cent. w/v gelatin. These three substances are, however, unsuitable for inclusion in size solutions, as they cause precipitates to form. Glycerin or turkey-red oil at concentrations of 0·5 per cent. v/v appear suitable as plasticisers for inclusion in both 5 per cent. w/v size and 5 per cent. w/v gelatin solutions.

PARKIN (E. A.). **D.D.T. Impregnation of Sacks for the Protection of stored Cereals against Insect Infestation.**—*Ann. appl. Biol.* **35** no. 2 pp. 233–242, 1 pl., 1 fig., 2 refs. London, 1948.

The following is virtually the author's summary. Cotton flour sacks, jute flour sacks, jute bran sacks and jute grain sacks were impregnated with 1 and 5 per cent. of their weight of DDT. Treated and untreated sacks, each

containing 1 cwt. of a 5 : 1 mixture of wheat and weatings, were securely closed, placed on the floor of a room in loose contact with one another, and exposed to severe infestation by adults of *Calandra granaria*, L., *Tribolium castaneum*, Hbst., *Ptinus tectus*, Boield., *Oryzaephilus surinamensis*, L., and *Ephestia elutella*, Hb., which were distributed as evenly as possible over them. After storage for 15 weeks at a mean temperature of 21·3°C. [70·34°F.] and a mean relative humidity of 65 per cent., the numbers of adult insects in each sack were determined by sieving the contents.

The results with *E. elutella* were few and inconclusive. The results with the four species of beetles showed that the eventual degree of infestation of the contents of the sacks was dependent upon the closeness of weave and the DDT content of the sacking material. Impregnation of sacking with 1 per cent. of its weight of DDT should afford adequate protection against insect infestation to clean bagged goods in stores that are not heavily infested. Impregnation with 5 per cent. DDT should offer a very high degree of protection at all times and can almost entirely prevent infestation, if the treated material is of sufficiently close weave to afford some mechanical hindrance to penetration by insects.

PRENTICE (I. W.). **Resolution of Strawberry Virus Complexes. II. Virus 2 (Mild Yellow-edge Virus).**—*Ann. appl. Biol.* **35** no. 2 pp. 279–289, 1 pl., 12 refs. London, 1948.

Experiments in England have shown that Aphids (*Capitophorus fragariae*, Theo.) allowed to feed for several days on a strawberry plant infected with yellow-edge transmit two virus fractions. These have been referred to as the viruses of mild crinkle and mild yellow-edge, but are here called virus 1 and virus 2. Virus 1 was the subject of a previous paper [*R.A.E.*, A **35** 207], and the isolation and properties of virus 2 are dealt with in the present one, the principal information in which has been noticed from a briefer account [**36** 376]. Two types of symptoms observed when it was transmitted to wild strawberry by *C. fragariae* suggested the possibility that it may itself be a complex of viruses.

PRADHAN (S.). **Studies on the Toxicity of Insecticide Films. I. Preliminary Investigations on Concentration-Time-Mortality Relation.**—*Bull. ent. Res.* **40** pt. 1 pp. 1–25, 1 pl., 12 figs., 27 refs. London, 1949.

The author gives a detailed account of laboratory studies on the toxicity of dry films left by sprays of DDT and γ BHC (the γ isomer of benzene hexachloride) in which a constant amount of spray per unit area was applied and the relation between concentration, duration of exposure and mortality was investigated ; the following is based on his summary. The test insects were adults of *Tribolium castaneum*, Hbst., and *Macrosiphum* (*Macrosiphoniella*) *sanborni*, Gill., and larvae of *Plutella maculipennis*, Curt., and the techniques adopted for keeping them in contact with the films are described. Adults of *T. castaneum* proved the most suitable for experimental work ; they cannot climb perpendicular glass surfaces, and can be kept in continuous contact with insecticidal films without difficulty. Attempts were made to reduce the fumigant effects of γ BHC progressively by confining the insects over films by means of cones of varying degrees of airiness, and to differentiate it from the effects of direct contact by confining them on muslin at a distance from films by means of inverted crystallisation dishes. The fumigant action of this compound was found to be considerable and apparently impossible to eliminate entirely, even when the insects were confined on muslin under open truncated cones.

The curves derived from plotting log-concentration against percentage mortality of *T. castaneum* were horizontal lines when there was no mortality and also when it was complete at all concentrations, but were sigmoid between these extremes and varied in slope with the duration of exposure. The average period for which the beetles survived gradually decreased as the concentration of the spray increased. The surface upon which toxic films of either material are deposited was shown in preliminary experiments to have a definite bearing upon their effectiveness against *T. castaneum*. Films on waxed surfaces showed lower and films on glass higher toxicity than those on filter paper and bolting silk, and films on leaves of *Geum* were more toxic than films on leaves of marrow, cabbage and water lily. When the concentration of insecticide was low, films on water lily were much the least toxic of those on leaves.

DAVIES (R. G.). **The Biology of *Laemophloeus minutus* Oliv. (Col. Cucujidae).**—*Bull. ent. Res.* **40** pt. 1 pp. 63–82, 7 figs., 60 refs. London, 1949.

Species of *Laemophloeus* have been found associated with the hot regions of bulk wheat that was heating as a result of insect infestation [*cf. R.A.E.*, A **36** 418], and since relatively little was known of their biology and importance as stored-product pests, investigations were carried out in England in 1940–41. The following is based almost entirely on the author's summary. The literature shows *L. minutus*, Ol., *L. turcicus*, Grouv., and *L. ferrugineus*, Steph., the three species commonly associated with stored products, to be cosmopolitan and to occur on a large variety of foodstuffs, which are listed for each. The immature stages of *L. minutus* are described and its life-cycle outlined. Eggs are deposited singly in flour or the fine débris associated with infested foodstuffs. The larvae pass through four instars and pupate in cocoons, which are often spun against a smooth surface within the larval food. Fertilised females oviposited continuously throughout their life (for over 239 days in one case) at the rate of about 0·5 egg per day at 17°C. [62·6°F.], rising to 4 per day at 30°C. [86°F.]. Changes in relative humidity between 55 and 90 per cent. had little effect on the rate of oviposition, which, however, was stimulated by the presence of the male. A detailed study was made of the effects of temperature (17–35°C. [62·6–95°F.]) and relative humidity (55–90 per cent.) on the rate of development and mortality of each stage in the life-cycle. The mortality of egg and pupa was hardly affected by changes in humidity, whereas larvae in the first instar, and to a lesser extent in later ones, succumbed readily to dry conditions and survived easily at 90 per cent. relative humidity. Temperature had little effect on mortality, except for a marked reduction of the viability of eggs at 35°C. Dry conditions tended to retard larval development somewhat, but temperature was the main factor determining the length of the life-cycle, the optimum lying between 30 and 35°C., at which temperatures it lasted about a month. Experiments on small cultures suggest that serious heating of bulk grain might result from a pure infestation of *L. minutus*. Completely undamaged grains were virtually immune from attack, but normal samples of wheat contain an appreciable proportion of grains with very small blemishes, which are accentuated by *Laemophloeus* and thus rendered suitable for its development.

COWLAND (J. W.) & EDWARDS (C. J.). **Control of *Empoasca lybica*, de Berg., on Cotton in the Anglo-Egyptian Sudan.**—*Bull. ent. Res.* **40** pt. 1 pp. 83–96, 1 pl., 2 figs., 1 ref. London, 1949.

This account of experiments on the control of *Empoasca lybica*, Berg., in the Anglo-Egyptian Sudan in 1944–46 includes a brief description of the life-cycle of the Jassid and the damage it causes to cotton [*cf. R.A.E.*, A **35** 292]. The following is largely based on the authors' summary. Initial cage

experiments showed that a water emulsion of DDT in xylene was far more effective than Bordeaux mixture or a proprietary copper-oxychloride spray and also more effective than emulsions containing the γ isomer of benzene hexachloride and more consistently so than DDT suspensions. The deposits from emulsions containing 0·1 and 0·05 per cent. DDT and 0·1 and 0·075 per cent. γ benzene hexachloride and a suspension of 0·2 per cent. DDT gave satisfactory mortalities for at least 11 days. Very young cotton was injured by an emulsion containing as little as 0·025 per cent. DDT, but emulsions containing up to 0·5 per cent. did not damage plants that were two months old. A coarse suspension of DDT caused severe leaf distortion, but a fine suspension used later proved quite safe at the concentration used (0·1 per cent.). In field experiments at the Gezira Research Farm and large-scale trials at three other places, in all of which the sprays were applied by means of power equipment, copper oxychloride did not give high mortalities, but emulsions containing 0·1 and 0·05 per cent. DDT gave excellent control and the deposits remained toxic to the Jassids for 2–3 weeks. The yield from areas sprayed with 0·1 per cent. DDT in the large-scale trials showed increases varying from 14·24 to over 37 per cent.

Dunn (J. A.). **The Parasites and Predators of Potato Aphids.**—*Bull. ent. Res.* **40** pt. 1 pp. 97–122, 5 figs., 22 refs. London, 1949.

The observations recorded in this paper were made in connection with the survey of potato Aphids in northern England [*cf. R.A.E.*, A **33** 358], in potato fields and in a small plot of potatoes in a suburban garden. Parasites were studied in 1944 and 1945 and predators in 1945, and a large part of the paper comprises notes on their appearance, bionomics and occurrence. The Aphids considered were *Myzus persicae*, Sulz., *Macrosiphum* (*Aulacorthum*) *solani*, Kalt., and *M. solanifolii*, Ashm., which were the chief species present. Lists are given of the primary parasites that have been recorded from them in various countries, and of the recorded hosts of *Aphidius avenae*, Hal., *A. ervi*, Hal., and *A. matricariae*, Hal., which, with *Praon volucre*, Hal., were the primary parasites found during the survey.

A. avenae was the most important parasite under field conditions and the only one collected in potato seed-growing areas. It attacked all three species, and three new British hosts, *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.), *M. rubiellum*, Theo., and *M. avenae*, F. (*granarium*, Kby.) are recorded for it. Its life-cycle in summer occupies about three weeks. Aphids parasitised by it were first found on potato about mid-July, and it probably completes two generations on this plant ; there are also one or two on other plants or hosts before July. A few adults may hibernate, but the winter appears to be passed mainly in the mature larval stage in cocoons formed from Aphid hosts in crevices or in dried fallen leaves. All immature stages were found in *M. onobrychis* and *Myzus persicae* on clover in an unheated glasshouse on 5th April 1945. The life-cycle of *A. ervi* resembled that of *A. avenae* ; it was reared from both species of *Macrosiphum*, but was seldom of importance in the field. *A. matricariae* was the most important parasite in the garden, where, however, it did not attack *Macrosiphum solanifolii*, although this was the most abundant Aphid present ; in the field it was reared only from *Myzus persicae* in two lowland areas. *P. volucre* was reared from all three Aphids in the garden, but only from *M. persicae* in the field, where it was rare. Parasitism by all these Braconids began about a month after Aphid infestation was established, but exerted obvious control at only one place, in the lowlands. It was higher in all three Aphids in 1944 than in 1945, and was highest in *Macrosiphum solanifolii* (15·7 per cent.). The hyperparasites observed comprised *Asaphes vulgaris*, Wlk., *Coruna clavata*, Wlk., three species of *Lygocerus*, three of *Charips*

and *Alloxysta* sp. Notes are given on their host relationships and habits and on their occurrence in the survey. All attack the immature stages of their Braconid hosts and pupate in the cocoons made by them, and in the survey reduced the possible numbers of the second generation of *Aphidius* on potato by nearly half. *Asaphes vulgaris* and *L. testaceimanus*, Kieff., comprised 70 and 20 per cent., respectively, of the total number of hyperparasites reared.

Syrphids and Coccinellids were the only predators that attacked the Aphids in the field, and only the former occurred universally. Those studied in the laboratory were reared on *Macrosiphum onobrychis*. *Platycheirus manicatus*, Mg., the life-history of which was hitherto unknown, and *P. scutatus*, Mg., were the most important, though neither alone exerted much control. The egg, active larval, quiescent larval and pupal stages of both occupied 3–4, about 15, 7 and about 15 days, respectively ; there are three larval instars, the winter is passed in the larval stage, and there are probably 2–3 generations a year, of which not more than one is likely to occur on potato. The life-history of *P. immarginatus*, Zett., which is also described for the first time, is similar but shorter ; this species was only encountered once. Immature stages of *Syrphus balteatus*, Deg., occurred irregularly in the fields, and where they were numerous, larvae of this species were responsible for almost all the control due to predators. Other Syrphids noted were *S. vitripennis*, Mg., *Melanostoma mellinum*, L., and *Sphaerophoria* spp. *Adalia bipunctata*, L., which occurred only in the garden, and *Coccinella septempunctata*, L., which gave complete control of Aphids where it appeared in swarms during early August, were the only Coccinellids. Other predators recorded in the garden were *Chrysopa carnea*, Steph., *Kimminsia subnebulosa*, Steph., a nymph of *Anthocoris* sp., Staphylinid larvae, Cecidomyiid larvae and spiders. Two fungi that attacked the Aphids in the garden were more important than the parasites in controlling *Macrosiphum solanifolii*, but were of little value against the other two Aphids. Heavy rains sometimes checked the Aphid populations. The numbers of healthy and parasitised Aphids of all three species recorded in the garden on 12 occasions between 19th May and 3rd August are shown on a graph, and, with the numbers attacked by fungi and the numbers of Syrphid eggs, larvae and pupae and of other predators, in a table. In general, it is concluded that parasites and predators appear too late (about mid-July) to prevent colonisation or to interrupt the development of the Aphid populations until infestation is already stable or declining.

O'Farrell (A. F.), Jones (B. M.) & Brett (G. A.). **The persistent Toxicity under standardised Field Conditions of Pyrethrum, DDT and "Gammexane" against Pests of stored Food.**—*Bull. ent. Res.* **40** pt. 1 pp. 135–148, 26 figs., 17 refs. London, 1949.

The persistent toxicity to insects of deposits of DDT and BHC (benzene hexachloride) make them likely to be of value in Britain for the treatment of storage premises, for which they are widely used in other countries. There is little information available on their use against pests of stored products under practical conditions, however, and studies of their persistence on various surfaces encountered in warehouses were accordingly undertaken. The sprays tested were 1·3 or 0·8 per cent. pyrethrins in P31 oil, 5 per cent. commercial DDT (70 per cent. p,p′ DDT) in kerosene, 1 per cent. DDT as a suspension in water, and 1 per cent. γ BHC in cyclohexanone and kerosene (1 : 9), and the dusts were 5 per cent. commercial DDT in talc and 4 per cent. crude BHC in kaolin (0·5 per cent. γ BHC). The test insects were adults of *Calandra granaria*, L., *C. oryzae*, L., and *Tribolium castaneum*, Hbst., and larvae and adults of *Ephestia kuehniella*, Zell. The following is based on the authors' summary.

The toxicity of films of pyrethrum in P31 oil persists on suitable surfaces, such as wood and cotton, under warehouse conditions for much longer periods (120 days) than was hitherto supposed, but sometimes shows unexplained fluctuations. Within the range tested, the pyrethrin content of the spray appeared to be only a minor factor in determining the persistence of toxicity, but the nature of the surface to which it is applied is of great importance. Persistence was negligible on concrete and greatest on wood and cotton ; the other substances tested, in order of increasing effectiveness, were brick, heavy hessian, light hessian and jute. Deposits of DDT or BHC derived from kerosene sprays are of little use on concrete, but showed fairly uniform toxicity on the other surfaces tested. Suspensions of DDT in water are non-inflammable, but had no other apparent advantage over oil solutions. The toxicity of the residues left by DDT and BHC dusts was apparently not influenced by the nature of the substrate, and it is therefore suggested that they might be of value for use on concrete. No other practical advantage attaches to the use of these materials as dusts, except that BHC appeared to give a more toxic residue in this form than in sprays. In general, DDT and BHC were more toxic to the two species of *Calandra* and to *Tribolium* than pyrethrum ; they were toxic to the adults but practically non-toxic to the larvae of *Ephestia*, which is better controlled by pyrethrum films. BHC appeared to be somewhat more effective than DDT, but more practical experience is required to establish this.

Macdonald (J. A.). **Experiments with D.D.T.**—*Scot. Agric.* **27** no. 1 pp. 7–9, 4 refs. Edinburgh, 1947.

A dust of 5 per cent. technical DDT (80 per cent. p,p′ DDT) in china clay and a spray containing 0·5 per cent. technical DDT in an emulsified solution were tested in 1946 in a field in eastern Scotland in which damage to carrots by *Psila rosae*, F., and to crucifers by club root (*Plasmodiophora brassicae*) had been severe each year since 1940, in an attempt to control both. The dust was applied on 24th April at the rate of 2 cwt. per acre to soil in which spring cabbage and winter broccoli were growing, potatoes had been planted but had not yet appeared above ground, and carrots, peas, beans and turnips were subsequently sown. The spray was applied on 22nd July at a rate of 90 gals. per acre to carrots that had been sown early in June but, owing to dry weather, were only 6 ins. high, and to potatoes, broccoli and cabbage. On examination in October, the spray and dust treatments were found to have reduced the total percentage of damaged and (in brackets) unsaleable carrots from 49·2 (5·1) to 37 (2·1) and 43·9 (3), respectively. The proportion of damaged roots in which the injury was slight was greater among sprayed than among dusted carrots. The quality of local carrots was poor that year, but in general that of the treated ones was good. Neither the growth nor the flavour of any of the crops was impaired by the treatments, but they had no effect on *P. brassicae* or late blight (*Phytophthora infestans*) of potatoes.

Läuger (P.), Pulver (R.), Montigel (C.), Wiesmann (R.) & Wild (H.). **Mechanism of Intoxication of DDT Insecticides in Insects and warm-blooded Animals.**—24 pp., 6 figs., 5 refs. New York, N.Y., Geigy Co., Inc., 1946.

From previous work, the authors concluded that the contact action of DDT is due to the high lipoid solubility of the trichlormethyl group and the toxic effect of the chlorbenzene system [*cf. R.A.E.*, A **33** 137 ; **35** 203], though the latter also possesses some lipoid solubility, and in this paper they give the preliminary results of further investigations in Switzerland on the way in which the toxic effect is brought about.

Many stomach poisons act by blocking enzyme systems. Thus, a compound that was found to be a very effective stomach poison for larvae of clothes moths was shown to cause blocking of pancreatin, which is important for protein decomposition in keratin-feeding insects, and a sulphonamide that had no effect on clothes-moth larvae or pancreatin *in vitro* but proved toxic to the Colorado potato beetle [*Leptinotarsa decemlineata*, Say], which feeds on leaves, was found to inhibit amylase, which is a carbohydrate-decomposing enzymatic system. DDT was known to affect the nervous system of insects and mammals, and the possibility that it does so by way of the enzymatic systems was investigated. It was found that DDT influences only few enzyme systems, but it caused an increase in the oxygen consumption of flies, which could be suppressed by barbiturate narcosis, and it was suspected that it has an affinity to the cholesterol of the lipoid membranes of the cells. The cholinesterase system is important for the conductivity of the nerve impulses.

In view of this increased oxygen consumption, the effect of DDT on the carbohydrate metabolism of mammals was studied. Tests with rabbits and rats showed that DDT intoxication is characterised biochemically by a prompt mobilisation of liver glycogen with augmentation of the blood sugar. The increased sugar consumption of the organism together with an increased production of lactic acid then leads to a prompt fall of the blood sugar to hypoglycaemic values, with simultaneous development of acidosis compensated at the expense of the alkali reserve. Intravenous injection of glucose during the hyperglycaemic phase did not influence the lethal course in rabbits, but injection directly after the fall of the blood sugar to hypoglycaemic values saved about half the animals. Adrenalin, which mobilises the glycogen stored in the skeletal muscles, affected the symptoms of intoxication but did not prolong the life of the treated animals. Permanent narcosis for 2–3 days increased the average duration of life and lowered the mortality of rats poisoned with DDT, and this suggests an action on the central nervous system.

As it was assumed that the concentration of glycogen was due to the sympathetic nervous system, the distribution of DDT in the organs was studied. It was found to reach fairly high concentrations in blood, liver, spleen, heart, brain and kidneys of rats 2–7 hours after intoxication and a very high maximum in the supra-renal glands after 5 hours. This suggested a relation to sugar metabolism, but it was found that the effect was the removal of glycogen from the liver following the addition of DDT to the cholesterol of the supra-renal glands. If, as this again suggests, DDT has a strong affinity to cholesterol, its action on the cells, especially those, such as the nerve cells, that contain large quantities of lipoids, would be to decrease the permeability of the lipoid membranes, resulting in impoverishment of the cells. When the supra-renal glands were ectomised in rats, DDT produced neither excitement nor tremors, but the animals died of exhaustion. This would indicate that DDT is a nerve poison.

The addition compound of DDT with cholesterol has a more tranquil effect on flies than DDT alone, but the insects lie on their backs in the same period of time. Cholesterol cannot be synthesised by the insects, as it can by mammals, and this might be one of the reasons for the greater susceptibility of insects to DDT. Feeding flies with lecithin or cholesterol reduced the tremors, obviously by affecting the permeability of the lipoid membranes.

Investigations on the process of detoxication in insects and mammals are described. It was found that the symptoms of intoxication in insects increase considerably after 30 minutes, though the DDT content of the thoracic ganglia reaches its peak at that time and decreases thereafter until death ensues, indicating that the destruction of the nervous system has progressed so far that all physiological functions must cease. Histological studies showed a vacuolisation of the cytoplasm and dissolution of the cell nucleus of nerve

cells only. DDT is largely excreted from the bile in mammals and from the Malpighian tubes into the end gut of insects. The process takes place very rapidly in insects, even during distribution to the central nervous system. The structure of the DDT molecule and its affinity to cholesterol are briefly discussed in the light of work still in progress.

Dunn (J. E.), Dunn (R. C.) & Smith (B. S.). **Skin-sensitizing Properties of DDT for the Guinea Pig.**—*Publ. Hlth Rep.* **61** no. 45 pp. 1614–1620, 7 refs. Washington, D.C., 1946.

Negative results were obtained in attempts by several methods to induce cutaneous hypersensitivity to DDT in guineapigs. Positive results in experiments reported in 1944 may have been due to impurities in the DDT used. Histopathological changes in the skin following injection of DDT in maize oil and of maize oil alone are described.

Walker (K. C.). **Problems relating to the Removal of DDT Spray Residue from Apples.**—*J. agric. Res.* **78** no. 10 pp. 383–387, 4 refs. Washington, D.C., 1949.

The following is from the author's summary of the results of two studies in Washington relating to DDT spray residue on apples. The first was on the effect of washing on the removal of DDT residue, the second on the effects of certain spray adhesives and spreaders on the DDT deposit and of overhead sprinkling on its removal.

When 42 apple samples with an original DDT residue ranging from 5 to 22·3 parts per million were washed by three different treatments, a high percentage of the washed samples had a significant amount of DDT residue removed. Nevertheless, none of the treatments removed enough from all samples to make it practicable for commercial use. In a single unit washer at 100°F., 60 lb. sodium silicate per 100 U.S. gals. water gave a more efficient DDT residue removal than 1·5 per cent. hydrochloric acid, and it was as effective as a tandem wash of sodium silicate followed by hydrochloric acid. When the original DDT residue on apples exceeded 10 parts per million, the standard washing practices in north-central Washington were not sufficient consistently to reduce this residue to a point equal to or less than the tolerance of 7 parts per million.

In the second study, the deposit on apples from a spray of wettable DDT was significantly increased by the addition to it of light-grade summer petroleum oil, little increased by the addition of dry-casein-type spreader, and significantly decreased by the addition of liquid-soap-type spreader. Overhead sprinkling irrigation for 24 hours with an oscillating-sprinkler that delivers approximately 5 acre-inches of water in this period did not remove significant amounts of the DDT deposits left on the fruit by these sprays.

Goodhue (L. D.). **Determination of Freon-Insolubles in Pyrethrum Extract.**—*Soap & sanit. Chem.* **23** no. 1 pp. 133, 135, 1 fig., 1 ref. New York, N.Y., 1947.

The following is substantially the author's introduction and summary. Pyrethrum extract for use in aerosol bombs should be as free as possible from substances insoluble in Freon-12 (dichlordifluoromethane) because they interfere with the performance of the dispenser and give trouble in the manufacturing process. Their removal also removes most of the substances irritating to the nose and thus reduces the unpleasant effect that pyrethrum extract has on some people.

A simple method of determining the amount of material in pyrethrum extract that is insoluble in Freon-12 and in aerosol formulations containing it is described. U.S. Army specifications for pyrethrum extract for aerosols allow only 4 per cent. material insoluble in pure Freon-12, but the amount actually found in samples examined ranged down to as little as 0·1 per cent., and the amount of material insoluble in typical aerosol formulations is generally less, ranging from 0·025 to 0·5 per cent.

Plank (H. K.). **Grassworm Injury to Lawns in Puerto Rico.**—*Trop. Agriculture* **24** no. 1–3 pp. 7–8, 2 refs. Trinidad, 1947.

In the summer of 1946, *Laphygma frugiperda*, S. & A., *Pachyzancla phaeopteralis*, Gn., and *Crambus ligonellus*, Zell., extensively defoliated the lawn grasses, *Paspalum conjugatum* and *Polytrias praemorsa*, at Mayaguez, Porto Rico. They caused only moderate injury to *Zoysia matrella*, which has been gaining in popularity as a lawn grass, and *Cynodon dactylon*, and seemed to avoid *Eremochloa ophiuroides*. Infestation began in June, was at its height in the latter part of July and ceased in August, and, with the resumption of the seasonable rains, recovery of the grasses was well under way in 2–3 months.

Birds (*Holoquiscalus*) were observed to be feeding on the larvae, and many of those of *L. frugiperda* were attacked by a disease. *Spilochalcis femorata*, F., was reared from larvae of *C. ligonellus*, and small white cocoons of an unidentified Braconid were found near larvae of *Laphygma*.

Muesebeck (C. F. W.). **Two new Species of *Apanteles* from California (Hymenoptera : Braconidae).**—*Pan-Pacif. Ent.* **23** no. 1 pp. 21–24, 1 ref. San Francisco, Calif., 1947.

The two new species of *Apanteles* here described from California are *A. medicaginis*, which parasitises larvae of *Colias eurytheme*, Boisd., on lucerne, and *A. praesens*, which parasitises *Anacamptodes fragilaria*, Grossbeck, and has been sent to Hawaii, where this Geometrid recently appeared [*R.A.E.*, A **37** 79]. *Apanteles medicaginis* very closely resembles *A. flaviconchae*, Ril., which is a gregarious parasite of the larvae of *Colias philodice*, Godt., on clover in the eastern United States, and when it first attracted attention in California, the author was inclined to regard it as a western race of *A. flaviconchae*. It was subsequently pointed out, however, that the Californian parasite always develops singly in its host [*cf.* **33** 81], so that its specific distinctness appears established.

Connell (W. A.) & Beacher (J. H.). **Life History and Control of the Oak Lace Bug.**—*Bull. Del. agric. Exp. Sta.* no. 265, 28 pp., 9 figs., 22 refs. Newark, Del., 1947.

The following is based on the author's summary. In recent years, *Corythucha arcuata*, Say, all stages of which are described, has caused serious discoloration of the leaves and late-summer defoliation of white oak (*Quercus alba*) in forest and ornamental plantings in Delaware, where this tree is commercially the most important hardwood. The feeding of the adults and nymphs on the lower surfaces of the leaves results in a reduction in the amount of food stored by the trees each year and in their rate of growth, and lowers their resistance to other insects and diseases. Field investigations on the bionomics and control of this Tingid were, therefore, carried out in 1941. All stages were found on the leaves of white oak from May to September, and injury was also observed on chestnut oak (*Q. montana*).

There were two complete generations a year and a partial third. The adults hibernated under loose bark scales on the trunks and larger limbs of white oak

and other trees, and flew to the leaves of white oak as soon as these began to appear. Oviposition by the overwintered, first and second generations continued from 4th May to 12th June, from 1st July to 4th August, and from 1st to 25th August, the numbers of eggs laid by females of these generations on leaves in observation cages averaged 21, 43 and 35, and the eggs hatched after averages of 18, 15 and 15 days. The nymphs, which are gregarious, developed in 2–3 weeks.

The rates of natural mortality of eggs and nymphs appeared to be about 20 and 33 per cent. No parasites were observed and only 2 per cent. of the eggs were destroyed by an unidentified predator, but the nymphs were killed by Syrphid larvae, the adults of a Mirid, *Hyaliodes vitripennis*, Say, and an Anthocorid, *Orius insidiosus*, Say, and a small spider. Six species of birds fed on the adults. Laboratory and field experiments showed that high mortality of eggs and nymphs and effective control can be obtained with sprays containing a suitable wetting agent and either one pint of nicotine sulphate or 2 gals. summer oil per 100 gals. spray, when applied at the rate of 25 U.S. gals. to trees about 30 ft. high. They should be applied during the third week in June, or when most of the first-generation nymphs have hatched, and a second treatment, during the early part of August, may be necessary if infestation is very heavy.

Dominick (C. B.). **Tobacco Flea Beetle Control.**—*Bull. Va agric. Exp. Sta.* no. 406, 19 pp., 5 figs., 4 refs. Blacksburg, Va., 1947.

In view of the good results obtained with DDT against flea-beetles [*Epitrix cucumeris*, Harr., and *E. tuberis*, Gentner] on potatoes in other States [*cf. R.A.E.*, A **33** 207 ; **34** 223 ; **35** 262], experiments were carried out in Virginia in 1946 in which it was compared with other insecticides, including BHC (benzene hexachloride containing 10 per cent. γ isomer), against *E. hirtipennis*, Melsh., which is the most important pest of seedling tobacco in that State [*cf.* **33** 45]. In moderately infested plant beds, very great reductions in flea-beetle populations were given in two days by applications with a hand duster of dusts containing 1, 2 or 3 per cent. DDT at the rate of 1 lb. per 100 sq. yards, and the dusts remained effective for at least ten days. Plants set in the field from the treated plots suffered less flea-beetle injury than those from untreated beds. Sprays containing ½, 1, 1½ and 2 lb. actual DDT per 100 U.S. gals. water, applied at the rate of 3 U.S. gals. per 100 sq. yards early in July, reduced the numbers of the newly emerged adults of the first generation by 88·8–96 per cent. in 24 hours. Neither the dusts nor the sprays injured the plants.

The concentrations of BHC used in dusts and sprays gave 1 per cent. γ isomer or 1 lb. γ isomer per 100 U.S. gals., respectively, except in the late-season spraying experiments, in which the concentration was halved. In comparative tests at the end of May in a tobacco bed in which the plants were 6–7 ins. high, the dust applied at 1½ lb. per 100 sq. yards and the spray at 4 U.S. gals. per 100 sq. yards completely eliminated the flea-beetles within 24 hours and the population was still insignificant ten days later. The BHC caused some injury to the plants, however, whereas a 3 per cent. DDT dust, though slightly less effective, caused none.

In tests on young tobacco plants newly set in the field, a stage in which they are readily attacked by flea-beetles, dusting in May with 1½ and 3 per cent. DDT at about 3 lb. per acre and spraying with 2 or 4 lb. DDT per 100 U.S. gals. water markedly reduced the average number of punctures on the most injured leaves, and protected the plants for about 14 days, the period required for them to become established in the field. Some protection was afforded by sprays of 3 lb. cryolite or 3 lb. basic copper arsenate and a dust of 10 per cent.

sabadilla. None of these treatments injured the plants. The BHC dust and spray were as effective as DDT, and the plants outgrew the slight injury caused by them. A spray of 4 lb. DDT per 100 U.S. gals. water applied to the plants in the beds a few hours before they were transplanted was about as effective as when applied directly to them in the field.

In field experiments in which two mid-season applications of insecticides were made to growing tobacco, the mortality percentages of flea-beetles three days after treatment on 7th June were 100 for 1 lb. DDT per 100 U.S. gals. water, 98·5 for a 3 per cent. DDT dust, 99·2 and 98·9 for the BHC dust and spray, 97·1 for a 1 per cent. rotenone dust and 90 for 6 lb. cryolite per 100 U.S. gals. All except rotenone gave substantial protection for a fortnight. Similar results were given by the second treatment on 13th July. In late-season experiments on late-maturing tobacco, sprays of $\frac{1}{2}$ lb. DDT and $\frac{1}{2}$ lb. γ BHC per 100 U.S. gals., applied at 85 gals. per acre, gave 98·7 and 99·3 per cent. reduction of population in two days ; basic copper arsenate (6 lb. per 100 U.S. gals.) gave 94·9 per cent., and undiluted cryolite dust at 30 lb. per acre gave 94·2 per cent. In all cases the populations were still low 12 days after treatment.

In tests on the duration of effectiveness of the spray deposits, tobacco plants were sprayed with 1 lb. DDT or γ BHC per 100 U.S. gals. and caged, and flea-beetles were liberated in the cages immediately and 10, 8 and 12 days after treatment. BHC gave complete mortality in 48 hours after 12 days, whereas DDT permitted some survivors at 8 days and many more at 12.

BHC was unpleasant to apply and its odour persisted for several days on the tobacco. DDT is therefore recommended as the best substitute for rotenone (the usual treatment against *E. hirtipennis*) if such is required.

Wallis (R. L.). **Time of planting Potatoes as a Factor in Prevention of Potato Psyllid Attack.**—*J. econ. Ent.* **41** no. 1 pp. 4–5, 3 refs. Menasha, Wis., 1948.

The following is largely based on the author's summary. A survey of populations of adults of *Paratrioza cockerelli*, Šulc, on early, medium and late plantings of potatoes from 1939 to 1946 in the North Platte Valley of Wyoming and Nebraska showed that potatoes planted in April are more subject to attack by this Psyllid than potatoes planted after 1st June. The average numbers on the medium and late crops (planted between 25th May and 10th June and between 20th and 30th June) were 37 and 28 per cent., respectively, of those on the early (April-planted) crop. The higher population on the early crop was apparently due to its growth during late June, when an influx of Psyllids from overwintering sources occurs, and to the fact that the plants reached their maximum growth in July, when critically high temperatures occur [*cf. R.A.E.*, A **36** 144]. These high temperatures retarded the development of the population on the small plants of later plantings.

It is concluded that the best time to plant potatoes in western Nebraska and eastern Wyoming to avoid high populations of the Psyllid is after 15th June. Particular attention to its control on early potatoes is necessary to produce a good crop and to prevent the carrying over of large numbers that will be injurious to later plantings.

Landis (B. J.). **Plants upon which Tuber Flea Beetles and Western Potato Flea Beetles propagate.**—*J. econ. Ent.* **41** no. 1 pp. 6–10, 9 refs. Menasha, Wis., 1948.

In addition to potato, adults of *Epitrix tuberis*, Gentner, and *E. subcrinita*, Lec., feed on a wide variety of crops and weeds in the Yakima Valley,

Washington, but do not reproduce on all of them. In order to determine their relative importance for the propagation of these two flea-beetles, certain plants that the adults feed on in the field were caged with larvae in the laboratory in 1941 and 1942, or the newly emerged adults were collected from traps put over naturally infested plants in a garden in 1942. It was found that the larvae developed on a great variety of plants, lists of which are given. Considerable reproduction of both species occurred on *Nicotiana alata* var. *grandiflora*, *Solanum rostratum* and *Physalis longifolia*, but these are of little importance because of their scarcity. Tomato, *S. dulcamara* and *S. villosum* were somewhat less suitable than potato, but occur in large numbers and appear to be a considerable source of production of both species for possible infestation of potatoes. Non-solanaceous crops on which both reproduced to some extent were cucurbits and beans.

The local practice of planting potatoes at intervals from 15th March until 10th July provides a succession of food-plants on which reproduction may occur for about 170 days. The early potato crop appears to serve as a means of concentrating the adults of *E. tuberis* as they emerge from hibernation, and timely applications of insecticides to this crop prevent the development of large numbers of first-generation adults, which might otherwise be difficult to control on later plantings of potatoes.

Davis (E. W.), Landis (B. J.) & Randall (T. E.). **A Potato resistant to Tuber Infestation by Flea Beetle Larvae.**—*J. econ. Ent.* **41** no. 1 pp. 10–12, 5 refs. Menasha, Wis., 1948.

The following is based on the authors' summary. In tests in western Washington in 1945 and 1946, a potato variety known locally as Doe Bay Red was found to produce tubers resistant to attack by larvae of *Epitrix tuberis*, Gentner. Comparative tests with Doe Bay Red and four commercial varieties showed that more larvae of this flea-beetle developed to maturity in hills of the Doe Bay Red variety than in any of the others, but the tubers showed consistently less injury by them. This resistance to injury could not be attributed to such differences as the set, size or yield of tubers. The Doe Bay Red potato evidently has some undetermined varietal characters that inhibit infestation of the tubers.

Bare (C. O.). **Laboratory Tests with Fumigants for Insects infesting stored Tobacco.**—*J. econ. Ent.* **41** no. 1 pp. 13–15, 1 ref. Menasha, Wis., 1948.

Laboratory tests of hydrocyanic acid gas, trichloracetonitrile and a mixture of acrylonitrile and carbon tetrachloride (1 : 1) as fumigants against the larvae of *Lasioderma serricorne*, F., and *Ephestia elutella*, Hb., two pests of stored tobacco, were carried out at Richmond, Virginia, in 1944–46. In tests at atmospheric pressure with dosages of 1–6 oz. fumigant per 1,000 cu. ft. at temperatures between 70 and 82°F., in which exposure was for 72 hours, 4 oz. HCN gave complete mortality of *L. serricorne* in open dishes and of *E. elutella* in maize meal, the mixture gave complete kills of *L. serricorne* at 4 oz. and of *E. elutella* at 6 oz. but not at 4½ oz., and 6 oz. trichloracetonitrile was required to kill both species. Small samples of flue-cured leaf tobacco that were exposed to 4½ oz. trichloracetonitrile or the mixture per 1,000 cu. ft. for 72 hours at atmospheric pressure and then allowed to stand for three days were no different in aroma, taste or appearance from untreated tobacco, and bales of Turkish tobacco exposed to 16 oz. of either fumigant for 72 hours were found similarly unaffected ten days after fumigation.

When nearly mature larvae of *L. serricorne* were inserted by means of test spikes to depths of 1–9 inches in bales of Turkish tobacco, the mixture gave complete mortality at all depths when the insects were exposed to rates of 20 oz.

per 1,000 cu. ft. for 72 hours, 28 oz. for 48 hours or 32 oz. for 24 hours at atmospheric pressure, at which penetration by HCN is very poor. For an exposure of 72 hours, 32 oz. trichloracetonitrile was needed to produce the same result.

In tests at reduced pressure (about 28 inches mercury), the mixture gave complete mortality of larvae of *L. serricorne* exposed at depths of 1–9 inches in bales of Turkish tobacco to 20 oz. per 1,000 cu. ft. for three hours at temperatures above 70°F. It is concluded that the mixture is a promising fumigant for stored tobacco. At comparable dosages, it penetrated better and was more effective than trichloracetonitrile or HCN, and its warning odour is better than that of HCN.

Brett (C. H.) & Rhoades (W. C.). **Grasshopper Control with Parathion, Benzene Hexachloride, Chlorinated Camphene, and Chlordan.**—*J. econ. Ent.* **41** no. 1 pp. 16–18, 3 refs. Menasha, Wis., 1948.

Grasshoppers generally concentrate in comparatively small areas in Oklahoma. Lucerne fields along creeks or in river valleys are a source of green succulent food into which economically important species move shortly after hatching, and very dense populations are produced when the lucerne is cut and the grasshoppers move into the vegetation left round the margins of the fields. Such circumstances offer an opportunity for quick and effective control by means of dusts, sprays or aerosols of some of the recently developed insecticides [*cf. R.A.E.*, A **36** 99].

In this paper, the results are given of tests carried out in Oklahoma during the spring and early summer of 1947, chiefly with dusts. In the first, which was made on tall weeds in June at a temperature of 50–60°F. and a wind speed of 10–20 miles per hour, the population consisted of nymphs of *Melanoplus bivittatus*, Say, and adults of *M. mexicanus*, Sauss., in the proportion of 95 : 5, and in the second, on lucerne in July at 83–92°F. and wind speeds of 0–5 miles per hour, it consisted of nymphs of *M. differentialis*, Thos., and adults of *M. bivittatus* and *M. mexicanus* (95 : 3 : 2). In the first experiment, the percentages dead in 24 hours were 91 and 8 for 2 and 1 per cent. parathion at 20 lb. per acre, respectively, 100 for 10 per cent. γ BHC (γ isomer of benzene hexachloride) at 50 lb. per acre, 74·5 for 5 per cent. γ BHC at 10 lb. per acre, and 22·1 and 34·5 for 20 and 10 per cent. chlorinated camphene [toxaphene] at 40 lb. per acre. In the second, they were 97 and 80 for 2 and 1 per cent. parathion, 92 for 5 per cent. γ BHC, 32 and 29 for 20 and 10 per cent. toxaphene, and 33 for 5 per cent. chlordan [formerly known as chlordane], all at 10 lb. per acre. The results with parathion showed that its effectiveness is increased at high temperatures ; most of the mortality caused by it occurred within 8 hours. Toxaphene was slow in action but gave complete control after 6 days. Its effectiveness and that of chlordan were probably reduced by rain.

In a subsidiary test with a fog generator in late July in a field of lucerne in which the grasshopper population consisted of nymphs and adults of *M. differentialis* and adults of *M. mexicanus* (75 : 20 : 5) and the temperature was 100°F., 2 per cent. γ BHC in water, released at the rate of 5 U.S. gals. for two acres, gave 81 per cent. mortality in 24 hours, and 3 lb. chlordan concentrate in 3 U.S. gals. diesel oil for two acres gave 26 per cent. in 72 hours. The method appeared unsatisfactory, owing to excessive drift of the aerosols.

Gaines (R. C.) & Young (M. T.). **Benzene Hexachloride Mixtures to control four Cotton Insects.**—*J. econ. Ent.* **41** no. 1 pp. 19–22. Menasha, Wis., 1948.

Experiments with dusts containing BHC (benzene hexachloride) for the control of *Anthonomus grandis*, Boh., *Aphis gossypii*, Glov., *Lygus oblineatus*,

Say, and *Alabama argillacea*, Hb., on cotton were carried out in cages and field plots in Louisiana in 1946. Laboratory tests showed that it had acted as a fumigant on all four insects. In cage tests, in which the insects were released on the plants soon after dusting was completed and the BHC was mixed with pyrophyllite or calcium arsenate, there was a highly significant correlation between the percentage of γ BHC in the pyrophyllite dusts and the mortality of *Lygus* and *Anthonomus*. Moreover, 1·44 per cent. γ BHC with pyrophyllite gave 78 per cent. mortality of *L. oblineatus*, whereas with calcium arsenate it gave only 26 per cent. Against *Anthonomus* 2·88 per cent. γ BHC in pyrophyllite was required to obtain mortality equal to that from calcium arsenate alone (64–65 per cent.), and the addition to calcium arsenate of 0·4–1·44 per cent. γ BHC did not increase mortality. Seven commercial mixtures diluted to contain 5 and 2·88 per cent. γ BHC were about equally effective against *L. oblineatus* and *A. grandis*, but there were some significant reductions on further dilution to 2·5 and 1·44 per cent. γ BHC, respectively, three giving about the same mortality of the weevil at both strengths and four considerably less. These results seemed to indicate that the actual content of γ BHC of some of the materials varied from that stated by the manufacturer. In cage tests against *Alabama argillacea*, dusts containing 2·88 per cent. γ BHC gave 80 per cent. mortality, and calcium arsenate 86 per cent.

In a field plot experiment in which five weekly applications of dusts were made from 18th July to 15th August, γ BHC gave significantly better control of the weevil at 5·75 per cent. and slightly better at 2·88 and 1·44 per cent. than calcium arsenate, but the results were not satisfactory and indicated that more frequent treatment was required. All the BHC dusts gave excellent control of *Aphis gossypii*, and calcium arsenate increased infestation by it, but only calcium arsenate and 5·75 per cent. γ BHC caused significant increases in yield over no treatment. In similar tests with mixtures of calcium arsenate and BHC, the yields were no better than with calcium arsenate alone. In field tests against heavy infestations of *A. gossypii*, there was a significant correlation between the γ isomer content and the percentage reduction of Aphids, dosages of 4 oz. or more γ BHC per acre being required to give consistently satisfactory control of heavy infestations. Red spiders [*Tetranychus*] were more numerous on cotton that had been dusted several times with BHC than on untreated cotton or that dusted with other insecticides, and this compound killed many beneficial insects.

Dunnam (E. W.) & Calhoun (S. L.). **Benzene Hexachloride to control Boll Weevil and Cotton Aphid.**—*J. econ. Ent.* **41** no. 1 pp. 22-25, 1 ref. Menasha, Wis., 1948.

The following is based on the authors' summary. Tests were carried out in 1945 and 1946 near Stoneville, Mississippi, to compare BHC (benzene hexachloride) with calcium arsenate and nicotine in dusts for the control of *Anthonomus grandis*, Boh., and *Aphis gossypii*, Glov., respectively, on cotton.

BHC at a concentration of 5 per cent. γ isomer was as effective as calcium arsenate, alone or with 1 per cent. nicotine from nicotine sulphate or zinc nicotinyl fluosilicate, against *Anthonomus* when applied at the same rate at intervals of four or five days, but the effect of BHC lasted no longer than that of calcium arsenate, and was not sufficient when the interval was extended to seven days [*cf.* also preceding abstract].

Aphids were controlled at concentrations as low as 0·5 per cent. γ BHC; there was strong evidence of a fumigant action that kept the population at an extremely low level in all plots, including adjacent ones dusted with commercial-grade calcium arsenate. Additional information is needed before the effect of mixing BHC and calcium arsenate can be decided, as they appeared

to be compatible in one test and not in another. The persistent musty odour and irritating effects of BHC are a disadvantage, and much additional information is needed before this compound can be generally recommended.

ARANT (F. S.). **Status of Velvetbean Caterpillar Control in Alabama.**—*J. econ. Ent.* **41** no. 1 pp. 26–30, 2 refs. Menasha, Wis., 1948.

Anticarsia gemmatalis, Hb., causes severe damage to groundnuts throughout south-eastern Alabama at irregular intervals and some damage in Geneva and Houston counties almost every year. Experiments on its control by means of dusts were carried out during a major outbreak in 1946, and the following is largely taken from the author's summary of this account of the work. Single applications of DDT, cryolite or BHC (benzene hexachloride) on 20th August protected groundnuts from serious damage until harvest on 19th September. Infestation counts showed that DDT was effective for the longest time and BHC for the shortest. Dusted plots produced higher yields than undusted ones. In one experiment in which dusts were applied at the rate of 35 lb. per acre, the average yields were 946 lb. dry groundnuts per acre for no treatment, 1,519 lb. for 1 per cent. DDT and 1,248 lb. for 3 per cent. DDT. In another, in which the untreated plants were ragged but not defoliated, the average yields per acre were 901 lb. for no treatment, 1,324 lb. for cryolite (1,123 lb. if the application was delayed until 2nd September), 1,114 lb. for 3 per cent. DDT and 1,323 lb. for 5 per cent. γ BHC, and in a third, plots dusted with 1 per cent. γ BHC at the rate of 20 lb. per acre yielded 1,468 lb. groundnuts, as compared with 1,164 lb. from untreated plants, which were not completely defoliated. In a field in which dusting was delayed until the plants were more than 90 per cent. defoliated, the yields per acre of dry groundnuts at the second digging were 699 lb. for no treatment, 1,232 lb. for cryolite, 1,222 lb. for 1 per cent. DDT and 1,032 lb. for 1 per cent. γ BHC.

Residue studies indicated that DDT persisted on groundnut foliage for several weeks after dusting. The amount on groundnut hay varied from two to 31 parts per million. Eight of 13 samples of hay contained more than the tentative tolerance for certain foods of 7 p.p.m., and all samples below the tolerance were from fields on which about 6 ins. rain fell during the 4–5 weeks between dusting and harvest. Livestock fed for 102–143 days on hay and maize containing DDT stored DDT in the fat and passed it in the milk. The amount stored in the fat varied from 13 p.p.m. in pigs to 160 p.p.m. in steers, and a calf suckled by a cow fed on hay from clover that had been dusted with DDT stored 825 p.p.m. in its fatty tissues. All the animals appeared normal. The hay in these feeding experiments contained considerably more DDT than was found on groundnut hay under field conditions.

WELCH (H.). **Tests of the Toxicity to Sheep and Cattle of certain of the newer Insecticides.**—*J. econ. Ent.* **41** no. 1 pp. 36–39. Menasha, Wis., 1948.

The following is partly based on the author's summary of this account of observations made in 1946 to determine the toxicity to sheep and cattle of DDT, methoxy-DDT, chlordan and BHC (benzene hexachloride containing 10 per cent. γ isomer). The maximum safe, single dose per kg. body weight for sheep appeared to be somewhat less than 0·5 gm. DDT, considerably less than 0·5 gm. chlordan, and somewhat less than 0·75 gm. BHC, while methoxy-DDT produced no toxic effects at the dosage used (2 gm. per kg.). The materials were administered by stomach tube, chlordan in an emulsified solution and the other materials in water suspensions. In similar tests with cattle, the maximum safe, single dose of DDT again appeared to be somewhat less than 0·5 gm. per kg. Chlordan, BHC and methoxy-DDT produced no toxic effect at 0·05, 0·125 and

0·5 gm. per kg., respectively. All were administered in water suspensions. The effect of administering the compounds in capsules to sheep daily for 60 days was then examined. Two sheep were used to test each substance. In these tests, 4·5 gm. DDT per day produced severe symptoms of poisoning after ten days. These disappeared on discontinuing the dosage for four days. In one sheep, they reappeared on the 20th day after the resumption of the experiment but disappeared after two days without dosing and remained mild until the end of the experiment. In the other sheep, they soon recurred when the treatment was resumed, and the animal was discarded from the test. One capsule containing 3·5 gm. chlordan and 1 gm. xylene was extremely toxic, and half the dose ten days later was almost equally so. After another five days, the sheep were given daily doses of 1 gm. of the mixture (0·77 gm. chlordan), and one survived (with two days' interruption in dosing) until the end of the experiment with only mild symptoms. The other sheep died after seven days, and postmortem examination revealed extensive liver necrosis, but it is not known whether this was caused by the chlordan. Sheep receiving capsules containing 2 gm. xylene alone showed no effect. Capsules containing 2·25 gm. BHC for 60 days produced only intermittent, mild symptoms, and capsules containing 4·5 gm. methoxy-DDT produced none. Six sheep allowed to graze for 21 days on pasture that had been sprayed immediately before with chlordan at 1 lb. and 4 lb. per acre (amounts equal to the quantity used as an insecticide and in excess of it) showed no sign of poisoning over the same period.

KERR jr. (T. W.). **Control of the Cornfield Ant in Golf Greens.**—*J. econ. Ent.* **41** no. 1 pp. 48–52. Menasha, Wis., 1948.

The following is based on the author's summary. Experiments were carried out in Rhode Island in 1947 on the effects of sprays prepared from wettable powders in reducing the numbers of hills made by the ant, *Lasius niger americanus*, Emery, in golf greens. Chlordan proved very effective, and benzene hexachloride moderately so, but DDT, chlorinated camphene [toxaphene] and methoxy-DDT were ineffective. There was a wide difference in effectiveness between two commercial brands of chlordan containing the same amount of active ingredient. A given amount of chlordan per unit area was more effective in a small than a large quantity of water. None of the materials tested damaged the grasses [*Agrostis* and *Poa*].

CHANDLER (S. C.). **Control of Peach Cat-facing in Illinois.**—*J. econ. Ent.* **41** no. 1 pp. 52–55, 2 refs. Menasha, Wis., 1948.

Most of the following is based on the author's summary. A dust containing 5 per cent. DDT, 57 per cent. sulphur and 5 per cent. oil at about 8 oz. per tree and a spray containing 1 lb. actual DDT as a wettable powder per 100 U.S. gals. water at 2–4 U.S. gals. per tree, applied to peach in Illinois when 50 per cent. of the blossoms were open and again when the shucks were just cracking, in order to attack the tarnished plant bug [*Lygus oblineatus*, Say] at its peak and Pentatomids at their first appearance [*cf. R.A.E.*, A **33** 316; **35** 84], reduced cat-facing of the fruits by about 80 per cent. in 1946 and 57 per cent. in 1947. Applications made to the leguminous cover crop in the orchard in a limited number of cases were about as effective as treatments applied to the trees. Either of these two applications alone gave relatively very good control in 1946. In 1947, when two applications were made in every case, delaying the first until petal fall resulted in about two-thirds as good control as applying it when the peaches were in bloom. In one test in 1946, a miscible oil containing 5 per cent. DDT and 5 per cent. BHC (benzene hexachloride), applied in the delayed-dormant stage, gave no appreciable control of cat-facing, and

neither wettable BHC (6 per cent. γ isomer) at 2–4 lb. per 100 U.S. gals., an oil dust containing 0·9 per cent. γ BHC or 61 per cent. water-miscible chlordan at 1 pint per 100 gals. gave any control of cat-facing in 1947 when applied five or more times from the shuck-split stage.

Holloway (J. K.). **Biological Control of Klamath Weed—Progress Report.**—*J. econ. Ent.* **41** no. 1 pp. 56–57, 2 refs. Menasha, Wis., 1948.

An account is given of the introduction of *Agrilus hyperici*, Crtz., *Chrysomela* (*Chrysolina*) *hyperici*, Forst., and *Chrysomela quadrigemina*, Suffr. (*Chrysolina gemellata*, Rossi) from Australia into California for trial against the noxious weed, *Hypericum perforatum*, and of the liberation of the last two [*cf. R.A.E.*, A **37** 107; **36** 216, etc.]. Importations were begun in October 1944. *A. hyperici* was received as mature larvae in roots, and some of these were placed in cold storage and others forced to emerge on arrival. Neither method proved satisfactory for adapting the life-cycle to the seasons of the northern hemisphere, and importations of this species were curtailed until material could be obtained from Europe. *C. hyperici* and *C. quadrigemina* were occasionally shipped as mature larvae, so that the adults would emerge on arrival, feed, and enter aestivation about three weeks later, but most of the shipments consisted of aestivating adults, and in order to bring them into the egg-laying phase they were subjected to fine sprays of water each day, with the result that fertile eggs were obtained within 2–3 weeks.

In 1944, sufficient numbers of *C. hyperici* were received for precautionary feeding tests, which were completed in May 1945 with no feeding or oviposition on any of the test plants [*cf.* **37** 107], and four colonies were released late in the season. One of these became established, but the survivors were so few that no recoveries were made until 1947. A total of 10,938 adults of this species, of which 3,500 were reared in the insectary, were liberated in 1945 and 1946 at nine sites in five counties of California. Seven of these colonies became established, and two have resulted in complete destruction of the weed within a radius of 15 yards round the original point of release.

Feeding tests with *C. quadrigemina* were completed in January 1946, and 13,650 adults in all were released in one locality in each of four counties in February, from imported material received during the preceding two months. All four colonies became established, and large increases were observed during the first partial generation. During the season of 1946–47, two of them spread considerably, and in April and May 1947 the adults could readily be found a quarter of a mile from the points of release. During the winter, the destruction of the basal growth by the larvae had been very apparent, and this feeding resulted in considerable reductions of new upright spring growth. The emerging adults stripped the remaining upright stems of all their leaves, so that areas several yards in diameter were devoid of any living weed.

Essig (E. O.). **Insects in relation to Weed Control.**—*J. econ. Ent.* **41** no. 1 pp. 58–61, 4 refs. Menasha, Wis., 1948.

The author cites examples to show that many important insect pests of cultivated plants require weeds as food-plants or for shelter, and that weeds and grasses also serve as reservoirs of virus diseases that are transferred to agricultural crops by insects. Weed control is therefore important in preventing the great financial losses caused by the destruction of crop plants. Brief notes are also given on the use of insects to destroy noxious weeds and the precautions necessary in introducing insects for this purpose.

Hodson (A. C.). **Further Studies of Lures attractive to the Apple Maggot.**—*J. econ. Ent.* **41** no. 1 pp. 61–66, 1 fig., 5 refs. Menasha, Wis., 1948.

Aqueous solutions of glycine, ammonium sulphate, ammonium acetate and household ammonia, which proved attractive baits for *Rhagoletis pomonella*, Walsh, on apple in earlier tests in Minnesota [*cf. R.A.E.*, A **32** 119], were tested further and compared with new chemical baits during the summers of 1943–47. A small amount of wetting agent was added to the various liquids. One of the objects of the investigation was to find a bait that would attract flies at a relatively constant rate for several weeks, and experiments were also designed to test the usefulness of baits in fly control, spray timing and the estimation of population numbers. In preliminary tests, bait pails 8 and 12 feet above ground level caught at least five times as many flies as those 3–4 feet up, pails on the south-west side of the trees caught nearly twice as many as those on the north-east, and pails on non-bearing branches caught less than those on bearing ones. There was no significant difference in the catches obtained in three weeks with baits of 1 per cent. household ammonia, 2 per cent. ammonium acetate or ammonium sulphate, or 2 per cent. urea with 3 per cent. sodium hydroxide, but 1 per cent. glycine with 1 per cent. sodium hydroxide was less attractive. However, the mixture of urea and sodium hydroxide was very attractive for five weeks, and its attractiveness seemed to remain relatively constant after the first week of exposure. A new type of dry trap was developed with ammonium-carbonate cubes or powder as the bait, and different forms of this are described ; in all of them the flies are retained by an adhesive on the inside or outside of the waxed-paper container. The dry traps caught slightly fewer flies than those containing household ammonia or the urea bait, but were as effective in attracting the first flies that appeared in the orchard and were much easier to transport and handle. They remained attractive for four but not five weeks.

One of the most practical uses of traps both for orchard management and for research purposes was to determine the approximate date of the first fly emergence, and it appears that the number of flies caught during the first two weeks of emergence gives a fair indication of the probable degree of infestation later in the season. Indirect evidence suggested that bait traps would not be practical as a commercial control measure against *R. pomonella*, since their effect apparently extended for only a few feet.

Gentner (L. G.), Morrison (H. E.) & Rasmussen (W. B.). **Aerosol Generator Applications of DDT for Codling Moth Control.**—*J. econ. Ent.* **41** no. 1 pp. 67–69. Menasha, Wis., 1948.

The following is mainly based on the authors' summary. In an experiment during 1946 in the Medford district (Oregon), DDT was applied by means of an aerosol generator for the control of the codling moth [*Cydia pomonella*, L.] on Bartlett pear trees. The experimental block received a calyx spray of cryolite and four applications of DDT as a steam-generated aerosol [*cf. R.A.E.*, A **35** 259]. A four-nozzle vertical boom was used for the first three applications and a single nozzle with swivel joint for the fourth. The first and second applications consisted of 2 lb. technical DDT dissolved in 1 U.S. gal. xylene and diluted with 4 U.S. gals. oil, the third of a commercial oil with a viscosity of 46 secs. Saybolt containing 4·5 per cent. DDT, and the fourth of 2 lb. DDT in 1 U.S. gal. xylene and 1·75 U.S. gals. oil emulsified with 1·75 U.S. gals. water and 0·5 U.S. gal. spreader. The insecticidal fog was forced into the trees from one side of each row only, and the DDT deposit on the fruit was much greater on that side. Very satisfactory control of *C. pomonella* was obtained, in spite of low deposits in some places, and the total cost of applying DDT in a 5 per cent.

solution with the aerosol generator at 0·5 U.S. pint per tree was less than half that of applying it as a 50 per cent. wettable powder by ordinary spray machinery at 10 U.S. gals. per tree.

A disadvantage of the method is that when DDT is used against *C. pomonella*, the addition of a suitable acaricide is necessary in some applications to prevent serious damage by spider mites, of which the dominant species in the area are *Tetranychus bimaculatus*, Harvey, and *T. willamettei*, McG.; preliminary tests in which DN-111 [containing a dicyclohexylamine salt of dinitro-o-cyclohexylphenol] and hydroxypentamethylflavan as wettable powders were used with the generator gave unsatisfactory results, owing to poor deposits. Good kill of mites was obtained with the last DDT treatment on the portion of the tree nearest the nozzle, but not on the far side.

GRAHAM (L. T.). **Criteria of Effect used in determining Codling Moth Injury.**—*J. econ. Ent.* **41** no. 1 pp. 70–75, 5 refs. Menasha, Wis., 1948.

Various criteria have been employed to evaluate damage to apples by larvae of *Cydia* (*Carpocapsa*) *pomonella*, L., but no uniformity of usage exists, and investigations on the suitability of several criteria were carried out in Iowa in 1939–40. The relation of number of injuries to number of injured fruits and of number of entries by larvae to number of entered fruits, all per 100 apples, on trees sprayed with arsenicals, was determined. These pairs of numbers increase in different ratios, but all tend to increase in geometrical progression, and both pairs can be fitted by the equation $Y=aX^b$, where Y is the number of injuries or entries, and X the number of injured or entered fruits, and a and b vary with locality and season. From analysis of the data, it is concluded that in the comparison of insecticides that have no fumigant [or rapid contact] effect, a consideration of stings [superficial injuries] is unimportant, as no real difference in the number of stings results from treatments of different efficiency. The number of entries seems to be the most sensitive test, and the best when the samples are small, though the number of injuries avoids inaccurate records due to failure to differentiate entries and stings. The number of injured fruits lacks the sensitivity of the number of entries, but has the advantage that appreciably less work is involved in collecting the data. It has most significance in such matters as the evaluation of insecticides. The grower, who is concerned with the effect of infestation on grades of fruit, is interested in the numbers of entries, stings and total injuries. For field experiments in general, the number of injured fruits or the number of entered fruits will serve satisfactorily in making comparisons of different treatments. In critical studies, additional information may be obtained through the use of other criteria. It is shown that the ratio of entries to stings [*cf. R.A.E.*, A **9** 115] does not give dependable analyses.

RICHARDSON (C. H.). **A System of sampling and rating Codling Moth Infestations.**—*J. econ. Ent.* **41** no. 1 pp. 75–79, 6 refs. Menasha, Wis., 1948.

The following is based on the author's summary. Methods of evaluating insecticides for the control of *Cydia* (*Carpocapsa*) *pomonella*, L., that depend on data taken from picked apples at harvest furnish no information on the pre-harvest trend of infestations or on the relative size of broods, and they provide no basis for making changes in insecticide applications in the period before harvest. A method is proposed for taking infestation data at any time before harvest, in which apples selected at random are examined from the lowest branches to a point as high as can be reached conveniently and are tallied for infestation according to the criterion or criteria selected by the investigator.

Difficult cases can be decided by examination with a hand lens or by the use of a knife, but ordinarily, very few apples will be sacrificed in making the observations. The data furnish an index of infestation of sufficient statistical uniformity for the evaluation of insecticides and possibly for other purposes.

Either the entire lower periphery of the trees or any quarter of it provides suitable sample units. The south sides of trees were not significantly more heavily infested than other sides. The tendency for light crops to be more severely infested than heavy crops can be offset by including among the sample trees only those with approximately equal crops; for most purposes it is sufficient to estimate crop size from the ground. If dropping of fruit is not excessive, inclusion of the fallen apples adds little to the information gained from sampling those on the tree, but when dropping becomes excessive, a record of infestation in the dropped fruit may be necessary. For speed and convenience, the total number of blemished (infested and superficially injured) fruits per unit sample is the most suitable criterion for obtaining infestation data. Other criteria are discussed, and it is pointed out that the number of blemished fruit per unit is probably adequate for detecting any difference between insecticides of practical value to apple growers.

Sun (Yun-Pei). **Synergistic Action of Chlordan in Dusts containing Nicotine or Rotenone.**—*J. econ. Ent.* **41** no. 1 pp. 89–91, 5 refs. Menasha, Wis., 1948.

The joint action of chlordan and nicotine was tested in the laboratory against *Aphis fabae*, Scop., on nasturtium. Dusts were prepared by impregnating pyrophyllite with an acetone solution of chlordan and by mixing nicotine alkaloid directly with pyrophyllite and were applied separately at concentrations of 0·25–1 per cent. nicotine and 0·5–1 per cent. chlordan and in mixtures of equal quantities containing equal concentrations (0·125–0·5 per cent.) of each to infested plants. The results obtained showed that mixtures of nicotine and chlordan tended to be slightly more effective than would be expected from similar joint action of the insecticides, though the differences might not be great enough to prove synergistic action.

In tests on the joint action of chlordan and rotenone, a 0·1 per cent. rotenone dust, made by mixing cubé powder with pyrophyllite, a 2 per cent. chlordan dust, prepared as in the previous experiment, and a mixture containing 0·05 per cent. rotenone and 1 per cent. chlordan were tested at various rates of deposit against third-instar larvae of *Epilachna varivestis*, Muls., in dishes. The results indicated that the mixture produced a joint action greater than the independent action.

It is concluded that according to the loose definition of synergism as the action of mixtures of two or more insecticides that gives higher mortality than the additive mortality produced by the components used separately, the addition of chlordan to either nicotine or rotenone produced a synergistic action, but that according to the usage of this term by Bliss [*R.A.E.*, A **28** 200] and Finney [**30** 501], the mixture of chlordan and nicotine gave a joint action slightly greater than a similar joint action, whereas the mixture of chlordan and rotenone gave a joint action greater than the independent action as determined by Finney's method.

Sun (Yun-Pei), Rawlins (W. A.) & Norton (L. B.). **Comparative Toxicity of Chlordan, DDT, Benzene Hexachloride and Chlorinated Camphene.**—*J. econ. Ent.* **41** no. 1 pp. 91–97, 20 refs. Menasha, Wis., 1948.

The authors give lists of insects that have been found to be more, less or equally susceptible to chlordan as compared with DDT or with BHC (benzene

hexachloride), with references to the literature concerned and a summary, largely in tabular form, of the results of their own investigations in New York State on the comparative effectiveness of these three insecticides and toxaphene in dusts and DDT and chlordan in sprays to various species. The methods of applying the dusts and sprays in the laboratory, insectary and field are described.

In laboratory tests against Aphids, 2 and 5 per cent. chlordan dusts gave higher mortality of adults of *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.) and *M. solanifolii*, Ashm., than DDT and toxaphene but lower than γ BHC at the same concentrations, though an emulsion containing 20 gm. chlordan per 100 ml., diluted 1 : 300, was slightly less toxic to *Aphis gossypii*, Glov., at various ages than a similar spray of DDT. In greenhouse and field experiments against Aphids of various ages, chlordan was less effective than DDT against *M. onobrychis* and *M. solanifolii*, but more effective against the bean aphid [*A. fabae*, Scop.] and *Myzus persicae*, Sulz., and γ BHC appeared to be more potent than other insecticides used at the same concentrations. In laboratory tests, 0·1 per cent. chlordan dust gave 89 per cent. kill of nymphs and adults of *Melanoplus femur-rubrum*, Deg., whereas 3 per cent. DDT gave only 13·3 per cent., and in field-cage tests, 1 per cent. chlordan was nearly as effective as the same concentration of γ BHC, but was slower in action. Chlordan was more effective than DDT in 2 per cent. dusts against third-instar larvae of *Epilachna varivestis*, Muls., in the laboratory, but although 2 per cent. dusts of γ BHC, chlordan, toxaphene or DDT gave good control in the greenhouse, 3 per cent. chlordan or DDT dusts were not promising in the field. All these materials as 5 per cent. dusts gave poor control of the adults. In dusts against adults of *Diabrotica duodecimpunctata*, F., 0·5 per cent. chlordan was more effective than 0·5 per cent. DDT in the laboratory, but 3 per cent. chlordan was not quite so effective as 1 per cent. DDT in the greenhouse. In laboratory tests, 0·05 per cent. chlordan dust killed 88·4 per cent. of nymphs and adults of *Nemobius fasciatus*, Deg., in two days, whereas 1 per cent. DDT killed only 84·7 per cent. In 1 per cent. dusts, chlordan was less toxic than either DDT or γ BHC to *Trialeurodes vaporariorum*, Westw., and DDT, γ BHC and chlordan were all very toxic to medium sized larvae of *Laphygma* (*Prodenia*) *eridania*, Cram., whereas nicotine gave no mortality in two days. In greenhouse tests, dusts containing 2 per cent. chlordan, DDT or γ BHC gave excellent control of *Thrips tabaci*, Lind., on potted onion plants, the mortality being too high to show differences.

In tests against insects attacking potato, an emulsion concentrate containing 20 gm. DDT per 100 ml., diluted 1 : 500, gave slightly better control of *Epitrix cucumeris*, Harr., and much better control of *Empoasca fabae*, Harr., than a similar spray of chlordan, and 0·5 per cent. DDT dust was more effective than 3 per cent. chlordan dust against *E. fabae*. At a dust concentration of 1 per cent., chlordan was more effective than DDT against adults of *Leptinotarsa decemlineata*, Say, in the laboratory and greenhouse, but less effective against larvae in the last instar in the laboratory, though both materials were very effective against the latter in the greenhouse. In the field, 1 per cent. chlordan dust gave very good control of both adults and larvae. The same dust gave a much higher mortality than 3 per cent. DDT dust of *Lygus oblineatus*, Say, in preliminary laboratory tests.

In experiments with dusts against pests of cabbage, 1 per cent. chlordan or DDT gave good control of *Phyllotreta vittata*, F., in the greenhouse and field, but 3 per cent. chlordan was less effective than 3 per cent. DDT against last-instar larvae of *Pieris rapae*, L., in the laboratory and than 1 per cent. DDT against *P. rapae* and *Trichoplusia ni*, Hb., in the field. The DDT dust was by far the best treatment tested against *T. ni* but was less effective than a dust of 0·25 per cent. rotenone and 1 per cent. chlordan against *P. rapae*. Plots

treated with 3 per cent. DDT showed much heavier Aphid damage than those treated with 1 per cent. DDT, 3 per cent. chlordan or other insecticides. In tests with chlordan, DDT and BHC for protecting radish from *Hylemyia brassicae*, Bch., in which the soil was treated with 5 per cent. dusts, or aqueous suspensions of the dusts or emulsions containing 0·2 per cent. toxicant were poured on the soil round the plants, chlordan gave somewhat better protection than DDT. When dusts were applied to the soil, seed germination was 3·2 per cent. for γ BHC and 64, 48·2 and 62·4 for DDT, chlordan and no treatment, and when the suspensions were used, more than 90 per cent. of the young plants were killed by BHC one day after the first application, but DDT and chlordan caused no injury.

Dills (L. E.) & Odland (M. L.). **Cabbage Maggot Insecticidal Tests.**—*J. econ. Ent.* **41** no. 1 pp. 98–101, 3 refs. Menasha, Wis., 1948.

Hylemyia brassicae, Bch., often causes serious injury to cabbage, radish and related crops in Pennsylvania ; most of the damage is reported from early plantings, but infestation may be found later in the season, especially on turnips and swedes. Repeated tests have shown the value of mercuric chloride and mercurous chloride in reducing injury, but in view of the high cost of materials and application and the shortage of mercury, experiments to find more satisfactory and more readily available treatments, begun in 1943 [*R.A.E.*, A **33** 276], were continued in 1944, 1946 and 1947. In all, 23 substances were tested, almost all of them on radish, and a few on cabbage. The tests on radish were made by pouring solutions, emulsions or suspensions of the toxicants on the plants soon after the second pair of true leaves had begun to develop, only one application being made in most cases, and the plants were examined several times during the next five days. The only effective materials tested in 1946 were BHC (benzene hexachloride), containing 12 per cent. γ isomer, which gave very good control at concentrations of 0·07–0·53 per cent., DDT, which gave some control at concentrations of 0·2 and 0·4 per cent., and the dicyclohexylamine salt of dinitro-o-cyclohexylphenol, which prevented infestation at 0·1 per cent., but damaged the plants badly. The effectiveness of mercuric chloride was low, possibly owing to wet weather. In 1947, chlordan was the best of the various materials tested, and 0·1–0·4 per cent. BHC and 0·05–0·4 per cent. chlordan all gave excellent control. Chlorinated camphene [toxaphene] was also very effective at 0·4 per cent., and DDT and DDD were about as good as mercuric chloride.

In 1944, dusts containing 10 per cent. 2-ethylpyridine sulphate, 2-n-hexylpyridine, tar oil, or mercurous chloride or 4 per cent. mercurous chloride were applied to cabbage. Only the first resulted in significantly higher yields than no treatment ; the pyridine derivatives caused no damage to the plants, but the tar-oil dust delayed the crop slightly. In 1947, BHC gave better control than mercurous chloride, when both were applied as 1–8 per cent. dusts. Some plants treated with BHC were eaten either raw or cooked by 47 people, none of whom detected any objectionable flavour.

Wingo (C. W.) & Crisler (O. S.). **Effect of DDT on Dairy Cattle and Milk.**—*J. econ. Ent.* **41** no. 1 pp. 105–106, 2 refs. Menasha, Wis., 1949.

An account is given of tests in Missouri in which dairy cows were given daily doses of DDT approximating those they might ingest when eating dusted forage or licking themselves or other animals after being sprayed for the control of flies. Technical DDT was administered to the two test animals by means of capsule and balling gun each day except the four Sundays for

29 days, and they received the standard ration of dairy mash and lucerne hay and were milked once a day. Samples from each day's milking were tested for DDT against house-flies [*Musca domestica*, L.], and the cows were observed for clinical symptoms of DDT poisoning or other abnormalities each day. No symptoms of acute poisoning were evident, but the cows became slightly nervous and showed stiffness in the hind quarters during the first week. Milk production was halved at the end of the experiment, but this may have been due to the change from two milkings a day to one.

Milk from the cow that received a daily dose of 20 gm. DDT (an average of 43 mg. DDT per kg. body weight) for 25 days showed high toxicity 24 hours after the initial dose was administered, and this persisted for nine days, after which the toxicity of the milk to the flies varied from day to day, indicating that excretion of DDT through the milk fluctuated markedly. Ten days after the last dose, the milk ceased to be significantly toxic. Milk from the cow that received 5 gm. DDT (12·2 mg. per kg. body weight) per day failed to show high toxicity to test flies except on the eighth day. After 24 days the daily dose was increased to 40 gm. (97 mg. per kg.) for four out of five days, and the milk became highly toxic within 24 hours and remained so for three days. Fifteen days after the last dose was administered, the milk ceased to be toxic to the test flies.

HARDY (D. E.). *Aristotelia fragariae* **on Strawberries in Iowa.**—*J. econ. Ent.* **41** no. 1 p. 108. Menasha, Wis., 1948.

Aristotelia fragariae, Busck, which is a common pest of strawberry in the Pacific Northwest of the United States, but had not previously been recorded east of the Rocky Mountains [*cf. R.A.E.*, A **34** 181], appears to be well established throughout the northern half of Iowa, infestations being found in six localities ranging from the west border to within two counties of the eastern boundary in 1946. Severe damage was caused in several places, and many plantings were completely destroyed. *A. fragariae* overwinters in the strawberry crown as a full-fed larva and pupates in early spring. The adults emerge about mid-June and oviposit in late June and early July, and hatching reaches a peak about 15th July. The larvae wander over the leaf surface for a short time and then drop to the base of the plants, where they bore into the crown just below the bases of the leaves and become full-fed in September.

In preliminary experiments, one application of 5–10 per cent. DDT dust when hatching was at its peak apparently gave complete control. Untreated plants were destroyed by the infestation.

MEDLER (J. T.) & CHAMBERLIN (T. R.). **Seed Yields of Red and Ladino Clovers increased by Use of Insecticides.**—*J. econ. Ent.* **41** no. 1 pp. 108–109, 1 ref. Menasha, Wis., 1948.

Investigations on the effect of insect control on yield of seed were carried out in fields of red and ladino clover [*Trifolium pratense* and *T. repens latum*] in Wisconsin in 1947. Dusts of 2·5 and 5 per cent. DDT in pyrophyllite and a mixture of 2·5 per cent. DDT and 5 per cent. sabadilla (1 : 1) at 40 lb. per acre, and sprays containing 1 lb. DDT or chlordan or ½ lb. each of DDT and sabadilla per 100 U.S. gals. at about 100 U.S. gals. per acre were applied to ladino clover on 3rd July, about ten days before the maximum production of flower heads. All treated plots had higher average yields of seed than untreated ones, and the increases on the dusted plots (29–34 per cent.) were greater than those on the sprayed ones.

Sprays of 1 lb. DDT, 1 lb. BHC (benzene hexachloride containing 5 per cent. γ isomer), ½ lb. each of DDT and sabadilla, and ½ lb. each of DDT and

BHC per 100 U.S. gals. that were applied at 100 U.S. gals. per acre to red clover on 25th July, before the plants flowered, increased the average yields by 76, 29, 63 and 26 per cent., respectively.

The season was not favourable for heavy infestation of leguminous crops. Sweeps made when the insecticides were applied showed only light infestations of *Lygus oblineatus*, Say, and *Adelphocoris lineolatus*, Goeze, in both clovers and of larvae of *Hypera nigrirostris*, F., in red clover. Although extreme variations between replicates made it impossible to show significant differences between treatments by statistical analysis, DDT consistently gave the best yields, and its superiority was also evident during the same season in experiments on lucerne.

EBELING (W.). **Effect of Citrus Red Mites on a California Red Scale Population.**—*J. econ. Ent.* **41** no. 1 p. 109, 1 fig. Menasha, Wis., 1948.

In a study of the effect of the food-plant on the biology of *Aonidiella aurantii*, Mask., in California, it was found that the usual differences caused by plant species could easily be nullified or intensified by an accidental infestation of mites, either during or before the tests. A number of orange and lemon seedlings that had been infested with crawlers of *A. aurantii* subsequently became accidentally infested with *Paratetranychus citri*, McG. Over half the crawlers settled and continued development when the leaves were first infested, but only very limited numbers of the next generation did so, although settling and developing continued in a normal manner on seedlings that were free of mites, indicating that the mites, while able to continue their development on the plants, had rendered them unsuitable for the scale.

In a laboratory test, 30 adult mites were put on each of two leaves of an orange seedling, the petioles were smeared with an adhesive to prevent their escape, and a hundred crawlers of *A. aurantii* were placed on each leaf at various intervals for a fortnight. Those that settled and reached the "whitecap" stage, which requires less than two days, were counted and removed. The proportion that reached this stage was 50 per cent. at first, but decreased each day until the 12th, when none was found.

BARE (C. O.). **The Effect of prolonged Exposure to high Vacuum on Stored-tobacco Insects.**—*J. econ. Ent.* **41** no. 1 pp. 109–110, 2 refs. Menasha, Wis., 1948.

In the course of experiments with new fumigants against *Ephestia elutella*, Hb., and *Lasioderma serricorne*, F., at Richmond, Virginia [*cf. R.A.E.*, A **37** 336], the effect of prolonged exposure to high vacuum on these insects was tested in 1946–47. All stages of both insects were inserted in test spikes to depths of 1–9 inches in bales of Turkish tobacco and exposed to a vacuum of 28·1–29·3 inches for 24 hours or to 26·1–29·4 inches for 72 hours. The former resulted in practically complete mortality of adults and larvae of *L. serricorne* and adults, larvae and pupae of *E. elutella*, but in only 86–96 per cent. mortality of pupae of *L. serricorne* and no mortality of the eggs of either species, though hatching was retarded. The latter caused practically complete mortality of all stages of *L. serricorne* except the eggs and complete mortality of all stages of *E. elutella*. Since 82–96 per cent. of the eggs of *L. serricorne* hatched after exposure for 72 hours, this stage was subjected, not in tobacco, to a vacuum of 27·5–29·4 inches for 168 hours, after which one out of 250 eggs hatched, and to 27·3–29·3 for 240 hours, which gave complete mortality. No differences in mortality caused by depth in the tobacco were detected. Death appeared to be due largely to desiccation, and the resistance of the eggs of *L. serricorne* to their waxy covering.

Since the length of time required for vacuum alone to produce mortality was much greater than the usual 3–4 hours' exposure in vacuum fumigation, it is evident that the kills in the latter are due principally to the fumigants used, but the results indicate that if it were practicable to keep manufactured tobacco products in vacuum for some ten days, complete mortality of all stages of *L. serricorne* and *E. elutella* would result.

Graham (C.). **Control of Grasshoppers in Apple and Peach Orchards.**—*J. econ. Ent.* **41** no. 1 p. 111. Menasha, Wis., 1948.

During the summer of 1947, heavy infestations of *Melanoplus femur-rubrum*, Deg., and *M. differentialis*, Thos., were reported from several counties in western Maryland. Damage occurred mainly in orchards, but also on farm crops. Sprays of toxaphene, BHC (benzene hexachloride), hexaethyl tetraphosphate, tetraethyl pyrophosphate and DN-111 [dicyclohexylamine salt of dinitro-o-cyclohexylphenol] were applied against a heavy infestation in an apple orchard on 26th July, BHC dusts in apple and peach orchards on 21st August and sprays of chlordan and BHC in an apple orchard in which a large population was feeding on the clover cover crop and the leaves on a few lower branches on 4th September. All sprays were applied at 200 U.S. gals. per acre. Two preparations of BHC at concentrations equivalent to 0·12 and 0·25 lb. γ isomer, respectively, per 100 U.S. gals., gave 99 and 100 per cent. kill of young grasshoppers in July, but the second preparation at half its previous concentration (0·125 lb. γ isomer) gave only 75 per cent. kill of mature grasshoppers when applied in September. Sprays of 2·5 lb. toxaphene (as a 50 per cent. wettable powder) and of 4 oz. tetraethyl pyrophosphate per 100 U.S. gals. both gave 90 per cent. kill in July, but the other materials tested then were much less effective. In August, dusts containing enough BHC to give 1·2 per cent. γ isomer gave complete kill when applied at 100 lb. per acre with a portable duster and 50 per cent. when applied at 40 lb. per acre from an aeroplane ; and in September, sprays of 2 lb. 50 per cent. chlordan wettable powder and 1 U.S. quart 40 per cent. emulsifiable chlordan per 100 U.S. gals. both gave 99·5 per cent. kill.

Kowal (R. J.) & St. George (R. A.). **Preliminary Results of Termite Soil-poisoning Tests.**—*J. econ. Ent.* **41** no. 1 pp. 112–113. Menasha, Wis., 1948.

The preliminary results are given of some standard tests of soil poisons for the control of subterranean termites, in progress at Beltsville, Maryland, and Barro Colorado Island, Panama Canal Zone, since 1942 and 1943 ; additional ones were begun later at Saucier, Mississippi, and in the Canal Zone. They were made in experimental areas that were uniform in site, soil type and vegetative cover, and ten tests of each chemical treatment were made in an area. Holes 15 ins. in diameter and 19 ins. deep were dug, the soil removed (about 2 cu. ft.) was treated as it was replaced, and a wooden stake $2\times4\times18$ ins. in size was driven to a depth of 1 ft. in the centre of each plot.

At Beltsville, lead arsenate, used dry at 4, 8 and 16 oz. per cu. ft., and sodium arsenite, used dry and in 10 per cent. solution at low dosages, have given remarkable protection for four and three years, respectively, and sodium fluosilicate, cryolite and phenothiazine used dry have also shown promise, but diphenylamine and phthalonitrile, which appeared excellent in laboratory tests, have failed. Trichlorbenzene, alone and with 5 per cent. pentachlorphenol, is promising, but 5 per cent. pentachlorphenol used alone shows weakness at low dosages, and a dosage of 1 U.S. quart per cu. ft. may be the minimum from which effective protection can be expected. Orthodichlorbenzene has given very erratic results, even at a dosage equivalent to 1 U.S. gal. per 10 cu. ft.,

but it appears that DDT may be of some value, since no attacks have occurred in treatments with a 5 per cent. solution in fuel oil ; the value of this treatment was doubtful for some time, as stakes in soil treated with oil alone were unattacked for two years.

In the Canal Zone, termite activity is so severe that much higher dosages are necessary. Examination at the end of three years showed that all mixtures of creosote or orthodichlorbenzene with diesel oil in dosages up to 3·5 U.S. gals. per 5 cu. ft. failed completely, and 5 per cent. pentachlorphenol in diesel oil showed one failure at the same rate, but there were no failures with orthodichlorbenzene alone at this dosage. Sodium arsenite, which was used at rates equivalent to at least 3 U.S. gals. of 10 per cent. solution per 5 cu. ft., was completely effective. All untreated stakes were attacked, and most of them were completely destroyed. It appears quite likely that after five years all treatments, with the possible exception of the highest dosages of sodium arsenite, will have failed completely in the Canal Zone.

Numerous tests have been carried out on the practical application of soil poisons to control termites in buildings, often by labour that could not be closely supervised, and the occurrence of failures with some of the soil poisons that proved valuable under experimental conditions makes it clear that, regardless of the potential value of the poison used, treatment of the soil must be complete if termites are to be successfully isolated from wooden structures.

JUDD (W. W.). **Powder-post Beetles in imported Bamboo.**—*J. econ. Ent.* **41** no. 1 p. 113. Menasha, Wis., 1948.

Examination in November 1947 of a shipment of 40 stems of bamboo about 10 ft. long and 1–4 ins. in diameter, which had been imported into Ontario from Florida and was in the stock of a manufacturing company at Hamilton, revealed the presence of many adults of *Dinoderus minutus*, F., on the stalks and in a pile of fine wood powder at their base and of numerous emergence holes over their surface. Slight pressure on the sides of the stalks caused the walls to collapse, disclosing the wood riddled with galleries and a fine wood powder filling the cavities in the internodes. Beetles were crawling actively in the galleries of the wood, but no larvae were found.

WHITE (R. T.). **Application of Milky-disease Spore Dust with a commercial Fertilizer.**—*J. econ. Ent.* **41** no. 1 pp. 113–114. Menasha, Wis., 1948.

In order to find whether a dust containing the spores of *Bacillus popilliae*, which causes milky disease in larvae of *Popillia japonica*, Newm. [*cf. R.A.E.*, A **31** 243], could be applied to the soil in a mixture with a fertiliser and what effect a standard fertiliser would have on the viability of the spores, 24½ lb. standardised spore dust containing 100 million spores per gm. was thoroughly mixed with 400 lb. of a 10–6–4 commercial fertiliser on 8th October 1940 and applied on 10th with a tractor-drawn fertiliser spreader to about one acre of turf in a strip 38 ft. wide in the Mall area of Washington, D.C. About 25 million spores per sq. ft. were thus applied to soil with an average larval population of about 44 per sq. ft. Strips of grass each side were left untreated. Since the soil temperature was below that necessary for larval activity and spore development, no increase of disease before 1941 was expected. Surveys made in May and June 1941 revealed an average of 27 larvae per sq. ft. in the treated strip and about 21 in the untreated ones. No diseased larvae were recovered in May, but in June 8 per cent. of the larvae throughout the treated strip and none in the untreated strips showed symptoms of disease. Surveys in August, September and October 1941 showed that the average numbers of larvae per

sq. ft. and, in brackets, the percentage diseased were 22, 16 and 7 (11, 34 and 52) in the treated strip and 26, 21 and 11 (0·4, 0·5 and 1) in the untreated ones ; in 1942, the corresponding figures were 6, 2, 7 and 2 (17, 70, 38 and 30) in May, June, August and October in the treated strip and 12, 6 and 4 (1, 23 and 10) in May, June and October in the untreated ones. A survey in June 1943 showed an average of only one larva per sq. ft. with one-third of the total population infected, and subsequent observations continued to show a low population.

It is concluded that satisfactory distribution of the disease spores was obtained with the fertiliser spreader, with no reduction in the viability of the disease organism due to the fertiliser. The results were about the same as those usually obtained with the spot method of applying the spore dust, and confirmed that the milky disease will reduce high larval populations of *P. japonica* and that the disease organism may spread rapidly to neighbouring untreated areas.

Nickels (C. B.). *Cameraria caryaefoliella*, **a Pest on Pecan.**—*J. econ. Ent.* **41** no. 1 p. 114, 2 figs., 1 ref. Menasha, Wis., 1948.

Cameraria caryaefoliella, Clem., mines the leaves of pecan in all the parts of the United States in which this tree is grown. It is usually of little importance, but has been observed to cause considerable injury in southern Texas. At Crystal City, Texas, nearly full-grown larvae were found on 26th April and 25th October in 1941 and from 23rd to 30th April in 1945, and moths emerged from 18th May to 1st June in 1941 and from 15th to 24th June in 1945. In 1938, two moths emerged in August from a collection made at Blanco, Texas. The larvae usually destroy the upper and middle layers of infested leaflets, but do not attack the lower layer ; 1–12 mines may occur per leaflet, and they range in length from less than 2 to more than 25 mm. As many as 66 per cent. of the leaflets have been found infested, and as much as 23 per cent. of the area of infested leaflets has been affected by the mines. Most mines contain only one larva, but a small proportion may contain 2–4.

Parasites reared from *C. caryaefoliella* comprise unidentified species of *Chrysocharis*, *Eupelmus* and *Mirax*, and *Horismenus fraternus*, Fitch, *H. violaceus*, Ashm., *Paraleurocerus bicoloripes*, Gir., *Eulophus* (*Pnigalio*) *metacomet*, Crwf., and *Sympiesis nigripes*, Ashm. Slightly more than half the larvae collected on 8th June 1945 were parasitised, the highest parasitism being by *E. metacomet*, *Paraleurocerus bicoloripes* and *H. fraternus*.

Knowlton (G. F.). **Alfalfa Weevil Damage to Onions and Beans.**—*J. econ. Ent.* **41** no. 1 p. 115. Menasha, Wis., 1948.

Unusually severe and extensive damage to lucerne by *Hypera variabilis*, Hbst. (*postica*, Gylh.) occurred throughout Utah in 1947. The first crop was injured, and continuing infestation prevented new growth of the second crop, the fields remaining bare for 2–4 weeks or more after the first cutting. On one farm, onions, pole beans and pigweed (*Amarantus retroflexus*) growing near a stack of heavily infested lucerne hay were severely injured by the weevils that emerged from it. The weevils showed a tendency to congregate in large numbers on weeds on which they evidently did not feed.

Knowlton (G. F.). *Empoasca filamenta* **Damage.**—*J. econ. Ent.* **41** no. 1 p. 115. Menasha, Wis., 1948.

The author records an extremely heavy infestation of *Empoasca filamenta*, DeLong, on lucerne heavily shaded by cottonwood trees at Moab, Utah, in September 1947. The number of leafhoppers per sweep of the net averaged

about 17 in this area, but only 1·2 in the part of the field beyond it. The presence of the leafhoppers was first noted from very conspicuous foliage spotting and discoloration, and the lucerne was unhealthy and of shorter growth in the heavily infested area than in the rest of the field.

E. filamenta is common in potato fields throughout Utah and frequently causes obvious damage to potato foliage, particularly late in the season. It has also been collected from the foliage of beans, tomatos, egg-plant [*Solanum melongena*], peppers [*Capsicum*], cucurbits, sugar beet, celery and white sweet clover [*Melilotus alba*].

Doutt (R. L.). **Effect of Codling Moth Sprays on natural Control of the Baker Mealybug.**—*J. econ. Ent.* **41** no. 1 pp. 116–117. Menasha, Wis., 1948.

The Baker mealybug, which the author refers to as *Pseudococcus* sp. and not *P. maritimus*, Ehrh., in view of uncertainties in the taxonomy of the *maritimus* complex [*cf. R.A.E.*, A **36** 399], damages late varieties of pears grown in the Santa Clara Valley of California. Field observations on the effect on the natural control of the mealybug of DDT sprays applied against the codling moth [*Cydia pomonella*, L.] were carried out in 1947 in a commercial planting of pears and showed that the percentages of fruits with calyx colonies of mealybugs increased progressively from 6·7–10 in July and early August to 71·6 at harvest (23rd September) on trees that received a calyx and two cover sprays containing 1·5 lb. 50 per cent. wettable DDT powder [per 100 U.S. gals.], whereas it ranged from 0 to 6·7 throughout this period on unsprayed trees. Although attempts were made to colonise the Coccinellids, *Cryptolaemus montrouzieri*, Muls., and *Scymnus binaevatus*, Muls., the natural control of the mealybug on unsprayed trees was apparently due to *Chrysopa californica*, Coq. It was quite evident that the increase in the mealybug population on sprayed trees was due to suppression of natural enemies ; the DDT deposit remained so toxic to *Chrysopa* that its return to them was prevented for several months during the period when the mealybugs were most active.

Further evidence on the length of time that DDT deposits remain toxic to entomophagous insects in the field was obtained by caging adults of *S. binaevatus* with samples of sprayed and unsprayed foliage and bark collected weekly in the field and measuring the time that elapsed before mortality was complete. The results showed that DDT that had weathered on the foliage for four months was capable of killing all test insects within 24 hours ; mortality was less striking on the bark.

Bowen (C. V.) & Weigel (C. A.). **Comparative Toxicity of Nicotine, Nornicotine and Anabasine to Green Peach Aphid.**—*J. econ. Ent.* **41** no. 1 p. 117, 8 refs. Menasha, Wis., 1948.

The results are given of preliminary experiments on the comparative toxicity of aqueous solutions of anabasine, nicotine and nornicotine to *Myzus persicae*, Sulz. Infested leaves from potted cabbages were sprayed in the greenhouse and transferred to the laboratory half an hour later in order to avoid the effect of bright sunlight on the Aphids, and final mortality counts were made 24 hours after treatment. Large numbers of Aphids were affected and dropped from the leaves within the first half-hour, and the final mortality was 98–100 per cent. of all stages after treatment with 0·2 per cent. solutions of each alkaloid, alone or with 0·1 per cent. sodium lauryl sulphate as a wetting agent, and only slightly less for concentrations of 0·05 per cent., with or without the wetting agent. The alkaloids appeared to be equally toxic at these concentrations, but at 0·025 per cent., alone and (in brackets) with the wetting agent, the percentage mortalities for nicotine, nornicotine and anabasine were 52 (74), 90 (86) and

95 (90), respectively, as compared with 1·7 for no treatment and 0·8 for the wetting agent alone, showing that anabasine and nornicotine are considerably more toxic to *M. persicae* than nicotine at this concentration. No plant injury due to the insecticides was observed.

Jones (S. C.) & Rosenstiel (R. G.). **Parathion for Control of the Two-spotted Mite and certain Insects.**—*J. econ. Ent.* **41** no. 1 p. 118. Menasha, Wis., 1948.

The results are given of tests in Oregon with parathion dusts. When 0·25 per cent. parathion was applied against *Tetranychus bimaculatus*, Harvey, on lima beans on 11th September at the rate of 40 lb. per acre with a small hooded power duster, the percentages of mites dead two, six and 16 days later were 93·1, 55·8 and 19·4 ; the corresponding figures were 71·9, 74·3 and 36·7 for a 0·125 per cent. dust and 2·4, 20·2 and 9·9 in the controls. Parathion at 0·25 per cent. reduced the numbers of *Taeniothrips inconsequens*, Uzel, on Italian prunes by 84·7 per cent. in one day in the field, and caused 50 and 100 per cent. mortality of the cherry fruit-fly, *Rhagoletis cingulata*, Lw., in the laboratory in 14–30 hours and 36–68 hours, respectively. When parathion dust was compared with other materials on peach trees infested by *Anuraphis persicae-niger*, Smith, the mortality percentages one day later were 98·5 for 0·25 per cent. parathion, 77·4 and 76·7 for 5 and 10 per cent. DDT dusts, 100 for a spray of 3 lb. benzene hexachloride (12 per cent. γ isomer) per 100 U.S. gals., 100 for a spray of hexaethyl tetraphosphate (1 : 800), 87·8 for a spray of 2 quarts oil emulsion containing 25 per cent. DDT per 100 gals., 18·5 for 2 per cent. chlordan dust, 88·1 for a spray of nicotine sulphate (1 : 800) and 4·1 for no treatment.

Borden (A. D.). **Control of Codling Moth on Pears with a DDT Spray.**—*J. econ. Ent.* **41** no. 1 pp. 118–119. Menasha, Wis., 1948.

The results are given of experiments in 1947 with DDT sprays applied with a Speedsprayer [*cf. R.A.E.*, A **34** 195] for the control of the codling moth [*Cydia pomonella*, L.] in a pear orchard in California that had been sprayed with lead arsenate and had shown rather a high proportion of infested fruit at harvest in 1946.

An emulsion concentrate containing 36 per cent. technical DDT was diluted in the spray tank at the rates of 3 and 6 gals. per 500 gals. water and applied on 2nd April (when all the petals were off), 16th April and 2nd May with a Speedsprayer on which only two rows of jets were left open and every other jet was blocked out in these, leaving only 45 jets in operation. The jet opening was reduced to 0·05 in., so that a very finely divided mist with sufficient velocity to carry through and over the tallest trees was produced. The equipment was drawn at a speed of not more than 0·8 mile per hour down each tree space and thus covered both sides of each tree row. The amount of spray applied per tree averaged about 2 U.S. gals., and it took 60–75 minutes to apply the 500 U.S. gals. contained in the tank. The visible deposit on the foliage and fruit consisted of uniformly distributed, very fine round beads of spray that did not coalesce, and there was practically no run-off.

The DDT deposits on pears sprayed with 3 gals. concentrate per 500 gals. were 2·63 mg. per 50 fruits after the first application, 5·4 and 20·2 parts per million before and after the second, 3·4 and 10 p.p.m. before and after the third and 0·09 p.p.m. at harvest on 1st July. No injury to fruit or foliage from either concentration of spray was noted at any time during the season, and no larval entries were found in the fruit at harvest.

In this orchard, the Speedsprayer not only reduced the labour and equipment required for spraying against *C. pomonella* but also reduced the material cost of each application to about an eighth of that of bulk spraying.

Brunson (M. H.). **Secondary Parasites of the Oriental Fruit Moth through *Macrocentrus ancylivorus*.**—*J. econ. Ent.* **41** no. 1 pp. 119–120, 6 refs. Menasha, Wis., 1948.

In 1940 and 1945, observations were made in peach orchards in the vicinity of Moorestown, New Jersey, to determine the effect of secondary parasites of *Cydia* (*Grapholitha*) *molesta*, Busck, on the primary parasite, *Macrocentrus ancylivorus*, Rohw. Cocoons spun by parasitised larvae of *C. molesta* in corrugated cardboard were exposed singly on trees in mid-June, when cocoons of the first generation of *C. molesta* were present in the orchards, and allowed to remain for 11 days. They were then put separately in vials and kept at normal temperature for emergence. Secondary parasites attacked 68·7 per cent. of the cocoons, the percentage of secondary parasitism being 44·7–76·5 in four orchards in 1940 and 57·7–100 in five in 1945. The species of secondary parasites reared and (in brackets) the percentage parasitism of *Macrocentrus* by them in the two years were *Dibrachys cavus*, Wlk. (31·5 and 20·8), *Eurytoma appendigaster*, Swed. (6·8 and 32·6), *Arachnophaga frontalis*, Gah. (9·3 and 7·2), *Eupelmus spongipartus*, Foerst. (3·1 and 7·7), *Hemiteles* (*Gelis*) *tenellus*, Say (3·1 and 1·4), *Pimpla* (*Coccygomimus*) *inflata*, Townes (0·6 and 0·5), *Encyrtaspis semirufus*, Gah. (1·2 and 0), *Eupelmus cyaniceps* var. *amicus*, Gir. (0 and 0·5) and *Mastrus pilifrons*, Prov. (0·6 and 0·5) ; 2·5 and 5 per cent. of the cocoons of *Macrocentrus* were found to contain dead unidentified secondary parasites.

Despite its restriction in population by secondary parasitism, *M. ancylivorus* attacks a large proportion of the larvae of *Cydia molesta*, especially the second generation, in orchards in New Jersey and many other States where peaches are grown. Since it attacks the larvae while they are feeding in twigs, it could be liberated against both the first and the second generations. Mass liberations against first-generation larvae in southern New Jersey have not resulted in a significant reduction in infestation of ripe fruit, possibly owing to attack by secondary parasites, but excellent results have been obtained from liberations against the second generation.

Robertson (O. T.). **Tests with DDT, Benzene Hexachloride and Ryania for Pink Bollworm Control.**—*J. econ. Ent.* **41** no. 1 pp. 120–121. Menasha, Wis., 1948.

Field-plot and field-cage tests of insecticides against *Platyedra* (*Pectinophora*) *gossypiella*, Saund., on cotton were carried out at Presido, Texas, in 1946. In small-plot tests in which dusts of 5, 10 and 20 per cent. technical DDT in pyrophyllite were applied at various rates five times at weekly intervals, the control of green-boll infestation was directly proportional to the total amount of DDT applied per acre and ranged from 9 and 12 per cent. with 3·8 lb. per acre to 57 per cent. with 17·5 lb. In additional tests, 10 per cent. DDT in pyrophyllite gave somewhat better control than 1·43, 2·87 and 5·75 per cent. γ benzene hexachloride in sulphur or 50 per cent. *Ryania* powder in sulphur.

In tests under a field cage covering 0·55 acre and partitioned into three equal sections, there was no significant difference in the control obtained with the 10 per cent. DDT dust applied at 26·3 lb. per acre per application and a solution of technical DDT in xylene emulsified with water and applied with a hand sprayer at the rate of about 10 U.S. gals. spray (2·69 lb. technical DDT)

per acre per application. Both treatments were made 11 times at weekly intervals from 4th June, six days before the first bloom, until 12th August, when green bolls became scarce. The average percentages of the blooms and bolls infested and the yields of seed cotton per acre were, respectively, 3, 7 and 1,249 lb. in the dusted section, 4, 5 and 1,274 lb. in the sprayed section, and 38, 100 and 351 lb. in the untreated section. The application of about 29 lb. DDT per acre during the season thus prevented any damage, but since the deposit was probably more effective under the cage than it would be in the field owing to shade, and the partitions prevented moth migration into the treated areas, control was probably considerably higher than would be possible under field conditions.

When plants were dusted with 10 per cent. DDT in pyrophyllite at the rate of about 20 lb. per acre and immediately caged with 50 pairs of moths per cage, oviposition was reduced by 88 per cent., whereas when 50 pairs of moths were caged on plants for four days, after which the cages were removed (before any of the eggs had hatched) and the plants were treated with the same dust at the same rate, there was a reduction of only 8 per cent. in the number of larvae per boll 12 days after treatment, indicating that the control from DDT dust is due to moth mortality rather than to the mortality of newly hatched larvae.

SHIRCK (F. H.). **Collecting and counting Onion Thrips from Samples of Vegetation.**—*J. econ. Ent.* **41** no. 1 pp. 121–123, 2 figs., 4 refs. Menasha, Wis., 1948.

With the initiation of a research programme on the control of *Thrips tabaci*, Lind., on onion in southern Idaho, it became desirable to adopt some standard procedure for estimating thrips populations. An adaptation of the Berlese-funnel method [*cf.* also *R.A.E.*, A **37** 259] was found satisfactory for collecting thrips from the basal portions of onion plants, as well as from other vegetation. The sample to be investigated is placed in a cardboard cylinder, the tops of the leaves cut off, and the cylinder inverted over a 6-in. flower-pot. A collecting jar containing a little 0·5 per cent. formalin is connected under the hole in the bottom of the flower-pot, and the entire unit is subjected to heat and drying in a temperature cabinet, which causes the thrips to emerge into the jar. For onions, a drying period of 24 hours at 115°F. was used. A shorter drying period of 120° would be sufficient, but tests showed a higher recovery of thrips at the lower temperature after continuous drying for 24 hours.

High temperature within the range 100–125°F. is believed to be the primary cause of the abandonment of the plants by the thrips. Low humidity causes rapid wilting of the vegetation and thus hastens the movement of the insects, but its effect is difficult to evaluate, since the humidity inside the individual sample-drying unit is not necessarily the same as that inside the cabinet.

The advantages of this method are that a large number of samples can be handled at a time and counts made rapidly, that if counting cannot be done at once, the jars can be set aside until later, and that only thrips that are alive and able to leave the samples are counted. Examination to determine the number of thrips remaining on onion plants after drying for 24 hours at 115°F. showed only a few, most of which were dead. The method has also been successfully used for estimating thrips populations on onion seed heads, and on lucerne, clover and bean and pea plants. On types of vegetation that wilt readily a drying temperature as low as 110°F. may be used.

A simple drying cabinet provided with a heating element or heated with electric light bulbs was found satisfactory. Thrips seem to leave the samples equally well whether the cabinet is well-lighted or completely dark. A thermostat is needed to keep the temperature from becoming too high, and a small electric fan inside the cabinet to force circulation of air is useful.

DE ONG (E. R.). **Damage to Coffee by the Drug Store Beetle.**—*J. econ. Ent.* **41** no. 1 pp. 124–125. Menasha, Wis., 1948.

Damage to coffee during storage or transit due to attack by *Sitodrepa* (*Stegobium*) *panicea*, L., is apparently not common, but severe infestation throughout a shipment of several hundred bags of green coffee arriving in San Francisco from Colombia was recently observed. The beans showed rounded burrows made by the larvae and small depressions where the adults had fed, and frass was scattered through the coffee. About 36 per cent. of the shipment was infested, but the damage was distributed throughout the entire load and no bag was free from it. Infestation had obviously occurred before loading, as the life-cycle of the beetle is 3–5 times as long as the period of transit and the feeding burrows in the beans proved that at least one generation of beetles had emerged. It is thought that the interruptions in transport caused by the war must have led to increases in numbers of *S. panicea* in South American warehouses and plantations and that infestations will probably continue to appear until transport and warehouse sanitation are normal.

Fortieth, Forty-first, Forty-second and Forty-third annual Reports of the Department of Agriculture (British Columbia) for the Years 1945, 1946, 1947, and 1948.—186, 198, 189, 228 pp. Victoria, B.C., 1946, 1947, 1948, 1949.

In the course of the Reports of the Horticultural Branch for the respective years (pp. 35–60, 59–84, 60–86 and 60–89), all by W. H. Robertson, it is stated that the pear psylla [*Psylla pyricola*, Först.] continued to extend its range northward in British Columbia during 1945 [*cf. R.A.E.*, A **35** 33]. In experiments on its control in 1947, sprays of 4 per cent. dormant oil (viscosity 220) alone or with 1½ lb. 40 per cent. dinitro-o-cyclohexylphenol per 100 gals. applied to pear trees on 24th March gave complete control until early July without injuring the trees ; Psyllids that appeared then had evidently migrated from neighbouring unsprayed trees. In general, damage by the pear thrips [*Taeniothrips inconsequens*, Uzel] was less severe in 1945 than in the previous year. A dust of 3 per cent. DDT in talc applied at 200 lb. per acre to the soil of an orchard in which the populations emerging during April were the heaviest yet recorded gave promising control of newly-emerged adults, but a spray containing 1 lb. DDT, 3 quarts acetone and ½ pint Tergitol [sodium salts of higher carbon alcohol sulphates] per 100 gals. at 400 gals. per acre, and calcium cyanamide at 200 lb. per acre were not effective. Dormant sprays of 4 per cent. oil applied to the trees on 2nd March against the European red mite [*Paratetranychus pilosus*, C. & F.] were of little value against the thrips, but a 3 per cent. DDT dust and a spray containing ½–1 lb. DDT in 1–2 gals. stove oil per 100 gals., with an emulsifier, applied at the green tip or cluster-bud stages gave excellent control. A spray of ½ lb. DDT and 1 gal. distillate oil per 100 gals., with the emulsifier, applied to two varieties of pear against the larvae at the calyx period, caused some leaf injury, and brown lesions developing between the veins on the leaves of one resulted in a 30 per cent. drop of leaves and fruit. The mortality percentages of adults caged on branches of trees sprayed with 0·5 or 1 lb. DDT in 1 or 2 gals. stove oil, respectively, per 100 gals. and dusted with 3 per cent. DDT were 88, 97 and 84, respectively, as compared with 16 in the controls. In 1946, the thrips caused practically no losses in orchards that received a dormant spray of 1 lb. 50 per cent. DDT and 0·5 gal. stove oil per 100 gals.

Tank-mixed fixed nicotine, which was used on a commercial scale against the second generation of the codling moth [*Cydia pomonella*, L.] on apple for the first time in 1945, gave control equal to that from sprays of cryolite or lead arsenate, reduced mite populations somewhat, and left no undesirable residue.

DDT was superior to any material tested against *C. pomonella*, but trees sprayed with it were considerably damaged by the Pacific mite [*Tetranychus pacificus*, McG.], and in 1946, trees that received DDT in the later cover sprays were more heavily infested by this mite than any others in the orchard. In 1947, there was no marked difference in the effectiveness against *C. pomonella* of a schedule comprising two cover sprays containing 1 or 2 lb. 50 per cent. wettable DDT per 100 gals., followed by three of xanthone at 2 lb., and five cover sprays of 1 or 2 lb. of the DDT preparation supplemented in the last three by ½ lb. DN-111 [20 per cent. dicyclohexylamine salt of dinitro-o-cyclohexylphenol] per 100 gals. The average percentages of infested fruits and, in brackets, of fruits with superficial injuries varied from 0 (0·10) to 0·3 (0·32), but were 1·2 (2·3) on trees sprayed five times with 4 lb. cryolite, ¼ lb. monoethanolamine oleate and ½ gal. oil per 100 gals.; infestation on untreated trees was only 8·5 per cent. The number of applications of DDT required was investigated in 1948 by omitting one or more applications from a schedule of four cover sprays, three, on 8th and 24th June and 8th July, against the first generation, and the fourth, on 13th August, against the second. The percentages of infested and (in brackets) superficially injured fruits were 0·32 (0·76) when the spray series was 1, 3 and 4, 0·52 (1·5) when it was 1, 2 and 3, 1·6 (2) when it was 1 and 4, 1·64 (2) when it was 2 and 4, 3·96 (3·08) when it was 1 only, and 3 (3·2) when it was 1 and 2. The DDT was a 50 per cent. wettable powder at a concentration of 1·6 lb. per 100 gals. and an application rate of 27 lb. per acre. Stove oil (1 : 400) was added to the spray for the plot on which it was applied in applications 1, 2 and 3. Tests were also made concurrently of the efficiency of the Okanagan experimental sprayer, which enables sprays to be applied either by pumping the insecticide mixture through a bank of standard spray nozzles situated on one side of the fish-tail outlet of an air-turbine to the air-blast produced by the turbine, which atomises it, or by carrying steam and insecticide from a steam-generator into the air-blast by means of two fan nozzles on the other side of the fish-tail unit. All the necessary equipment is mounted on a low-slung trailer and operated by a Wisconsin air-cooled engine, and the change from one method of application to the other can be easily made. The capacity of the tank was 50 U.S. gals., the pressure at the pump 200–250 lb., and the velocity of the air-blast at the fish-tail approximately 100 miles per hour. The three cover sprays against the first generation were applied, 50 per cent. wettable DDT being used at 8 lb. per 25 gals. water and applied at 28 lb. per acre in the first two and at 6 lb. per 25 gals. and 21 lb. per acre in the third, with ½ gal. stove oil in each case. The percentages of infested and (in brackets) superficially injured fruits were 0·6 (1·6) for the first method of application and 0·52 (0·76) for the second. Six weeks after the last application, the deposits of DDT on the fruit in micrograms per sq. cm. were 6·7 for both methods on the bottoms of the trees and 2 and 2·6, respectively, on the tops, as compared with 2·9 on the bottoms and 1·6 on the tops for a conventional sprayer applying 27 lb. 50 per cent. DDT per acre in a similar schedule. Spraying 20 trees with the experimental sprayer required only a quarter as long. Parasites of *C. pomonella* were received from Ontario during the summer of 1946, and *Ephialtes caudatus*, Ratz., and *Cryptus sexannulatus*, Grav., were released in two orchards on six occasions between 13th June and 9th October.

Tests in 1946 on the control of *Paratetranychus pilosus* on pears indicated that infestation could be considerably reduced by two sprays of the dicyclohexylamine salt of dinitro-o-cyclohexylphenol (1 lb. DN-111 per 100 gals.) at an interval of not more than ten days. The ammonium salt at 2 oz. per 100 gals. was even more effective, but is not generally available and is difficult to mix in the spray. Sprays containing 1 pint Selocide [potassium ammonium selenosulphide] per 100 gals. in emulsions of summer oil with a viscocity of 65

gave satisfactory control of *P. pilosus* and *Tetranychus pacificus* on apple, but one of precipitated sulphur was of value only against the latter. In 1947, four applications, on 22nd May, 4th and 30th June and 31st July, of sprays containing 1 lb. 50 per cent. wettable DDT, 2 oz. dinitro-o-cyclohexylphenol and 1 oz. monoethanolamine per 100 gals. spray, or four of hexaethyl tetraphosphate, at 1 : 800 in the first two and 1 : 1,600 in the others, gave excellent control of a heavy infestation of *P. pilosus* on apple, and the hexaethyl tetraphosphate also gave good control of woolly aphis [*Eriosoma lanigerum*, Hsm.]. Ammonium dinitro-o-cresylate at 4 oz. per 100 gals. was ineffective.

In 1945, the San José scale [*Quadraspidiotus perniciosus*, Comst.] occurred throughout the Okanagan Valley [*cf.* **35** 98]. In experiments on apple with dormant oils, which give excellent control, two light oils with viscosities of 106 and 108 retarded the development of the buds, whereas a heavy oil with a viscosity of 204 caused little or no retardation. These oils were all used at a concentration of 4 per cent., but the oil with a viscosity of 106 was also satisfactory at 2 per cent. with the addition of $1\frac{1}{2}$ lb. 40 per cent. dinitro-o-cresol, 9·6 oz. DDT or 2 gals. lime-sulphur per 100 gals. A dormant spray of 2 gals. oil (viscosity 200–220) and 4 gals. lime-sulphur per 100 gals. water was recommended in 1947 ; thorough treatment every three years would probably be sufficient. In tests, dormant sprays containing 12 gals. lime-sulphur, 3 or 4 gals. lime-sulphur with 1 lb. soy-bean flour and 1 gal. heavy western petroleum oil, or enough BHC (benzene hexachloride) to give $\frac{1}{4}$ lb. γ isomer and 2 gals. heavy western petroleum oil, all per 100 gals., did not retard bud development, whereas 4 gals. heavy western petroleum oil and 1 lb. soy-bean flour caused slight retardation and 4 gals. light mid-continent petroleum oil with soy-bean flour or 4 gals. emulsive high paraffin petroleum both caused considerable retardation, though no economic losses. During the summer, a spray of cryolite and 0·5 per cent. summer oil was applied to the lime-sulphur plot and the rest of the orchard was sprayed with DDT against *C. pomonella*. On 12th September, infestation of the fruit by *Q. perniciosus* was estimated tentatively at 0·01 per cent. for all plots ; there was no unsprayed plot, but 10 per cent. of the fruits had been infested in the previous year, following a dormant spray of lime-sulphur. Surveys in the Okanagan Valley in 1948 showed that infestation was very much lower than in the previous year as a result of control measures.

The mealybug [*Phenacoccus aceris*, Sign.] caused little damage to apple in the Kootenays in 1945 owing to control operations [*cf.* **32** 326] and a warm, dry season. Parasites liberated during the previous five or six years [*cf.* **31** 152] had entirely eradicated it from several quite large orchards, and by 1946 had spread over a considerable area from the point of liberation ; further distributions of material collected locally were being made yearly. DDT combined with distillate oil was found in 1945 to be less effective in controlling *P. aceris* than either DDT or distillate oil alone, both of which should give good commercial control.

In an experiment against the buffalo treehopper [*Ceresa bubalus*, F.] on apple in 1946, a spray of 2 lb. 50 per cent. wettable DDT per 100 gals. on 15th May, nine days before the nymphs hatched, reduced the average number of oviposition incisions per limb in October, when oviposition was complete, from 22·4 to 14·6, one on 15th May followed by another on 6th September reduced it to 6, and one on 6th September only reduced it to 9. Treated trees appeared less stunted in growth than the controls. In a similar experiment in 1947, incisions were too scarce for reliable counts to be made but were only slightly fewer than on trees sprayed with DDT against *Cydia pomonella*, and it was concluded that the *Cydia* sprays must have controlled the nymphs almost completely in spring. In 1948, however, the DDT sprays applied by the grower against *Cydia* gave only partial control of *Ceresa bubalus* and 10 incisions per

limb were found in October, whereas the numbers per limb were 5·8 and 5 on plots that received a spring or autumn application of 2 lb. 50 per cent. DDT per 100 gals., respectively, and 3·1 on a plot that received both.

In 1947, dusts containing 3 per cent. DDT in talc or pyrophyllite or 2 per cent. γ BHC in diatomaceous earth, applied at about 80 lb. per acre to peach at the pre-pink stage, appeared promising against the tarnished plant bug [*Lygus oblineatus*, Say], though the results were inconclusive. In 1948, alternative materials to replace 10 per cent. lime-sulphur, which is expensive and difficult to apply, for use against the peach twig-borer [*Anarsia lineatella*, Zell.] were tested. The percentage of infested fruit at harvest was lower on trees sprayed in April with 3 lb. 50 per cent. DDT per 100 gals. (0·42) or 2 lb. 15 per cent. parathion per 100 gals. (0·56) than on trees sprayed with 10 per cent. lime-sulphur (1·51), but the results with parathion were inconclusive, since the crop was very light. Sprays containing BHC and diesel or dormant oil or 3 per cent. lime-sulphur and dormant oil were less effective.

A dust of 4 per cent. DDT applied to two fields of turnip grown for seed in 1945 was very effective against flea-beetles, but less so against the brassica seed-weevil [*Ceuthorrhynchus assimilis*, Payk.]. Two applications of the dust, on 1st and 18th June, appeared as effective as four of derris dust applied between 23rd May and 20th June.

The Reports for 1945 and 1946 each contain a Report of Provincial Entomologist (pp. 71–81 and 100–110) by I. J. Ward. *Leptinotarsa decemlineata*, Say, did not cause commercial losses of potatoes during 1945. Increased use of dust containing 0·75 per cent. rotenone reduced both the area and intensity of infestation in the East Kootenay district, and eradication of the beetle, which has been achieved in the Boundary area, appears possible there. A dust of 3 per cent. DDT was used on a fairly wide scale in 1946 and proved superior to any other yet tested ; it killed both adults and larvae and remained effective for five weeks after rainfall. The potato flea-beetle, *Epitrix tuberis*, Gentner, has increased rapidly in the interior since it was first recorded there in 1944 [**35** 43], and by 1946 light infestations occurred from the International Boundary through the Okanagan Valley to the infested coastal area. Quite severe infestations are present generally throughout the Lower Fraser Valley.

In general, the outbreak of *Melanoplus mexicanus mexicanus*, Sauss., that reached a peak in 1943–44 [**35** 34, etc.] showed a considerable decline in 1945, largely owing to parasitism, and little damage was reported. In the Nicola Valley, where *Camnula pellucida*, Scud., was also involved, populations were high and damage to range-land extensive, but control measures reduced losses of crops, and parasites had become very numerous in late summer. The decline continued throughout most of the Province in 1946 owing to parasitism and to cool, wet weather in spring, and, in one district, to heavy frosts in August. In the North Okanagan Valley, an outbreak of the Tettigoniids, *Anabrus longipes*, Caudell, and *Steiroxys trilineata*, Thos., in spring was controlled by cool, wet weather and no damage to crops occurred. In 1945, cutworms were numerous in spring, probably owing to wet weather, which appears to favour them but not their parasites. Early crops sustained some damage for the second year, but losses were minimised by the use of poison baits. A severe outbreak occurred in 1946 [*cf.* **37** 126], but again the use of poison baits reduced crop losses and gave almost complete control where they were applied prior to sowing or planting.

Owing to the increased use of a dust containing 4 per cent. mercurous chloride (calomel) for the control of *Hylemyia antiqua*, Mg., on onion [**35** 34], excellent crops of both bulbs and seeds were obtained throughout the interior in 1946. A prompt and thorough application of a dust containing 35 per cent. cryolite to a seed-crop of parsnips infested by the parsnip webworm [*Depressaria heracleana*, L.] in 1945 resulted in only slight losses, as compared with the

previous year [*cf.* **35** 34]. A heavy infestation of the orange tortrix leaf-roller [*Tortrix citrana*, Fern.] seriously damaged plants of many kinds in pots in a greenhouse in 1945. The only insecticide of any value was a spray of ½ lb. DDT in 10 gals. water with a spreader, of which several applications were required. It also proved effective against *Lygus oblineatus* on aster, and the chrysanthemum midge [*Diarthronomyia chrysanthemi*, Ahlberg], both in greenhouses. Aphids [*Phorodon humuli*, Schr.], red spiders and Lamellicorn larvae were the chief pests of hops in the Kamloops area in 1946, when a dust of hexaethyl tetraphosphate showed promise as a substitute for nicotine against the Aphids and gave excellent control of those sheltering in the bracts.

A heavy outbreak of *Hemerocampa pseudotsugata*, McD., on ornamental Douglas fir [*Pseudotsuga taxifolia*] in the city of Vernon destroyed many trees in 1946. DDT gave good results on trees that were small enough to be sprayed. The heaviest outbreak of the grape leafhopper [*Erythroneura*] experienced in recent years occurred in the Kamloops district and caused some damage to grape crops, though in general DDT sprays gave excellent control.

Grassé (P. P.). Ed. **Traité de zoologie. Anatomie, systématique, biologie. Tome VI. Onychophores, Tardigrades, Arthropodes, Trilobitomorphes, Chélicérates.**—$9\frac{3}{4}\times6\frac{1}{2}$ ins., [2+] 979 pp., 4 col. pls., 870 figs., refs. Paris, Masson et Cie, 1949. Price *Fr.* 5000. **Tome IX. Insectes. Paléontologie, géonémie, Aptérygotes, Ephéméroptères, Odonatoptères, Blattoptéroïdes, Orthoptéroïdes, Dermaptéroïdes, Coléoptères.**—$9\frac{3}{4}\times6\frac{1}{2}$ ins., [2+] 1117 pp., 3 col. pls., 974 figs., refs. 1949. Price *Fr.* 4500.

These volumes are the sixth and ninth of a treatise of which most of the others have not yet appeared. They give a detailed account of the morphology, anatomy, development, biology, distribution, palaeontology, evolution and systematics of the groups dealt with, illustrated by reference to individual species and supplemented by bibliographies. The first includes a general account of the Arthropoda by A. Vandel (pp. 79–158), accounts of the morphology and anatomy of the Arachnida by J. Millot (pp. 263–319) and of their embryology by C. Dawydoff (pp. 320–385), and more detailed treatments of the Araneae by J. Millot (pp. 589–743) and Acari by M. André (pp. 794–892). The second comprises an account of the classification, phylogeny, palaeontology and evolution of insects by R. Jeannel (pp. 1–110), and sections on the Apterygota by R. Denis (pp. 111–275), Ephemeroptera by R. Despax (pp. 279–309), Odonata by L. Chopard (pp. 311–354), Dictyoptera by L. Chopard (pp. 355–407), Isoptera by P. P. Grassé (pp. 408–544), Zoraptera by R. Denis (pp. 545–555), Plecoptera by R. Despax (pp. 557–586), Notoptera by L. Chopard (pp. 587–593), Cheleutoptera by L. Chopard (pp. 594–616), Orthoptera by L. Chopard (pp. 617–722), Embioptera by R. Denis (pp. 723–744), Dermaptera by L. Chopard (pp. 745–770) and Coleoptera by R. Jeannel and R. Paulian (pp. 771–1077).

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